ABDOMINAL SURGERY

VOLUME II.
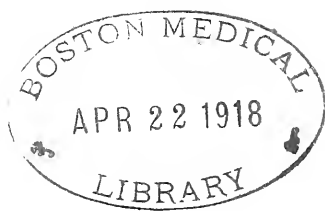
ABDOMINAL

SURGERY

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SUMMARY.

OPERATIONS ON THE INTESTINES.

THE surgery of the intestines provides the widest and most
varied field of work in the whole range of abdominal surgery.
The surgery is difficult; its results are least satisfactory; and,
perhaps in consequence of these facts, variety in technical
methods, always considerable in this branch of surgery, has
in the past few years almost passed legitimate bounds.   Proved
truths have been overlooked or forgotten, and methods already
tried and condemned have been resuscitated on the results
of a few experiments or the invention of a clever diagram.
The consequence has been that the surgery of the intestines
has not advanced in the way that the surgery of other abdominal
organs has advanced.   It has suffered, like every other branch
of surgery, since the beginning of the art, from the ignoring
of pathology and the multiplication of instruments and
apparatus.

It happens in intestinal surgery that the operative tolerance

of the patient is usually less than in other abdominal operations, and that the demands made on the skill of the surgeon in the technical part of his work are greater. The surgeon, therefore, should spare no pains in making himself familiar with the most approved methods, and should by practice make himself familiar with their technique. This familiarity may be, to a great extent, acquired in the post-mortem room, if practice on the lower animals is forbidden; a favoured few may get it by assisting other surgeons. However acquired, this technical skill is certainly indispensable to the surgeon who aims at the highest success in intestinal surgery. A fairly good method, skilfully performed, is better than the best method, clumsily performed. Elsewhere Nature seems to kindly cover our faults; here she seems cruelly to find out and expose them. In every case the saving of life should be the single aim in view. Better leave an intestinal fistula in a living body than a water-tight junction in a dead. It is poor surgery that, in getting a perfect operation, kills the patient.

It is true that here the most perfect surgery is the most difficult and the most trying. It has been proved, only too abundantly, that here there is no easy and rapid road to success; the perfecting of old paths and the improvement of tried methods of progress, will provide the most beneficent results.

SURGICAL AND TOPOGRAPHICAL ANATOMY.

Except at their extremities, and at one or two fixed points, there is no definite topography of the intestines. Treves,* as a result of careful examination in 100 bodies, came to the conclusion that accurate localisation was impossible. In the majority of adult bodies the following arrangement was found: "The small intestine is disposed in an irregularly curved manner from left to right. The gut, starting from the duodenum, will first occupy the contiguous parts of the left

* *The Anatomy of the Intestinal Canal and Peritoneum in Man.* Lond., 1885.

side of the epigastric and umbilical regions; the coils then fill some part of the left hypochondriac and umbilical regions; they now commonly descend into the pelvis, reappear in the left iliac quarter, and then occupy in order the hypogastric, lower umbilical, right lumbar, and right iliac regions. Before reaching the latter situation they commonly descend again into the pelvis."

Special interest attaches to a knowledge of the parts of bowel which usually occupy the pelvis. It is not till some three or four years after birth that the pelvis begins to accommodate intestine. According to Treves, the parts usually found in the pelvis of an adult "belong to the terminal point of the ileum, and to that part of the intestine which has the longest mesentery—the part, namely, which extends between two points, respectively six and eleven feet from the end of the duodenum. It is not, therefore, uncommon to find loops lying together in contact with the pelvic floor that are in reality some twelve or fourteen feet apart."

An examination of some twenty bodies, with a view to fixing the topography of the bowels, convinced the writer that the variations were too great to be of value in practical surgery. The average disposition, as described by Treves, though for the majority of cases probably correct, is yet liable to so many variations in individuals, that rules of practice cannot with safety be based upon it.

The attachments of the mesentery have some surgical importance. (Fig. 123.) In localising a certain portion of bowel, and ascertaining the direction of it from duodenum to cæcum, it may be of assistance to remember that the right layer of the mesentery is also its upper layer, and the left layer the lower. The upper layer is continuous with the lower layer of the transverse meso-colon, and also with the peritoneum which invests the ascending colon. The lower layer is continued over the descending colon, forms the mesentery of the sigmoid flexure, and descends into the pelvis. When the abdomen is not distended, the length of the mesentery is such that any part of the small intestine can easily be raised up through an opening in the abdominal wall near the umbilicus. When the abdomen is
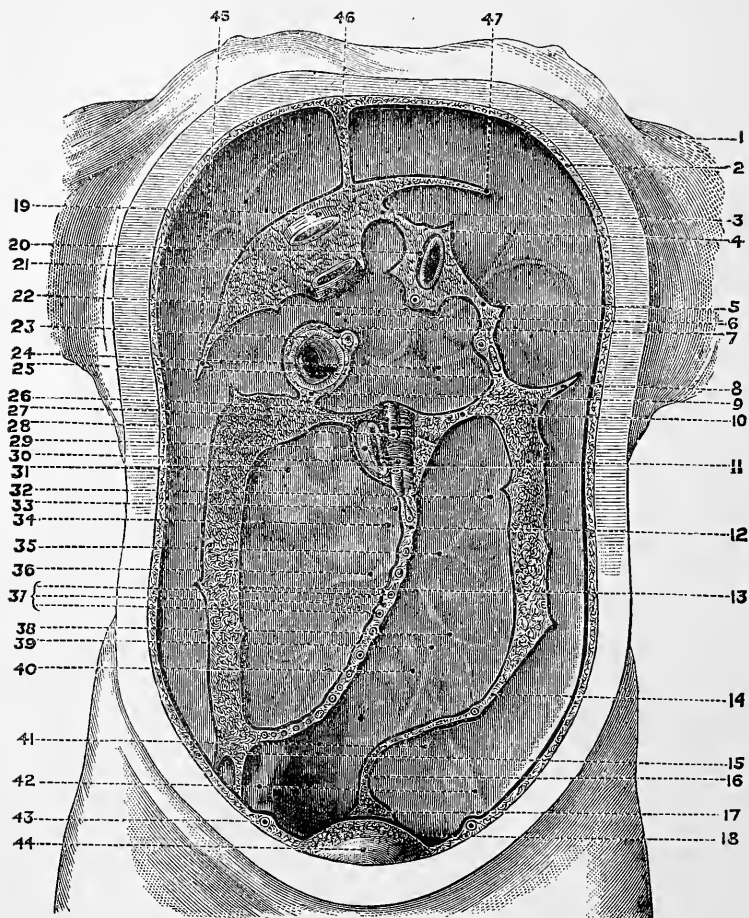
FIG. 123. (GRAY'S ANATOMY. 11th Ed.)

Diagram devised by Dr. Delépine to show the lines along which the Peritoneum leaves the Wall of the Abdomen to invest the Viscera.

1. Peritoneum. 2. Extra-peritoneal Tissue. 3. Diaphragmatic end of Gastro-hepatic Omentum. 4. Gastro-phrenic Ligament. 5. Gastro-splenic Omentum. 6. Foramen of Winslow. 7. Duodenum (1st part). 8. Costo-colic Ligament. 9. Dot between two Anterior Layers of Great Omentum. 10. Transverse Meso-colon. 11. Bare surface for Descending Colon. 12. The two layers of the Mesentery Proper. 13. Bare surface for Ascending Colon. 14. Sigmoid Meso-colon. 15. Bare surface for Cæcum. 16. Meso-rectum. 17. Bare surface for 2nd part of Rectum. 18. Left Lateral False Ligament of Bladder. 19. Vena Cava Inferior. 20. Œsophagus. 21. Right Phrenic Artery. 22. Coronary Artery. 23. Hepatic Artery. 24. Splenic Artery. 25. Pancreas. 26. Inferior Pancreatico-duodenal Artery. 27. Colica Media. 28. Superior Mesenteric. 29. Duodenum (3rd part). 30. Aorta. 31. Duodenum (2nd part). 32. Right and left Renals. 33. Superior Mesenteric. 34. Aorta. 35. Colica Sinistra. 36. Colica Dextra. 37. Vasa Intestini. 38. Sigmoid Artery. 39. Sup. Hæmorrhoidal Artery. 40. Common Iliac Artery. 41. Internal Iliac Artery. 42. External Iliac Artery. 43. Epigastric Artery. 44. Bladder. 45. Right Lateral Ligament of Liver. 46. Falciform Ligament of Liver. 47. Left Lateral Ligament of Liver.

distended, it may be impossible to bring certain portions of bowel through a median incision. Normally, according to Treves, the bowel cannot be dragged down below the level of the spine of the pubes. In elderly women with lax parietes the mesentery is long, and the bowels are permitted greater freedom of range.

The topography of the large bowel is more definite. With respect to the cæcum, Treves's investigations have shown the existence of very general misconception.* It has been generally held that the posterior surface of the cæcum is uncovered by peritoneum, and is attached by areolar tissue to the iliac fossa, thus bespeaking the existence of a meso-cæcum. Treves found, on the contrary, that the cæcum was always entirely enveloped by peritoneum, and lay free in the abdominal cavity ; that there was no sign of a meso-cæcum ; and that it usually lay upon the psoas muscle, so placed that its lowest point projected beyond the inner border of that muscle. In the great majority of instances the apex of the cæcum will be found to correspond with a point a little to the inner side of the middle of Poupart's ligament. The lower limit of the reflexion of the peritoneum from the under surface of the cæcum to the posterior surface of the abdominal wall—in other words, the lower border of the ascending meso-colon is a little below the level of the crest of the ilium.

The direction of the ascending and the descending colon is vertical, and the transverse colon lies almost horizontally between them. The splenic flexure is higher than, the hepatic, and lies deeper in the abdomen. And the transverse colon very frequently takes a bend downwards. These bends sometimes descend a considerable distance, occasionally reaching the pubes; but they rarely get below the level of the crests of the ilia. They are sometimes quite acute, forming **V**-shaped curves.

Of much surgical importance is the disposition of the ascend-

* Although it has recently been shown (Matas in *New Orleans Med. and Surg. Journal*, Dec., 1887) that twenty-five years before Treves wrote, Bardeleben and Luschka insisted on the fact that the cæcum is completely surrounded by peritoneum, and several German anatomists maintained the same view, I have preferred to leave the text as it was printed in the first edition, if only to show that, so far as we in England have been instructed, Treves's studies deserve to be considered as discoveries.

ing and descending meso-colon. It is generally supposed that a
meso-colon is more common on the right side than on the left,
and this is often quoted as an argument in favour of left lumbar
colotomy. Treves found the reverse to be the case. "In fifty-
two (out of a hundred) bodies there was neither an ascending
nor a descending meso-colon. In twenty-two there was a
descending meso-colon, but no trace of a corresponding fold on
the other side. In fourteen subjects there was a meso-colon to
both the ascending and the descending segments of the bowel;
while, in the remaining twelve bodies, there was an ascending
meso-colon, but no corresponding fold on the left side. It follows,
therefore, that in performing lumbar colotomy a meso-colon may
be expected upon the left side in 36 per cent. of all cases, and on
the right side in 26 per cent."

It may perhaps be right to remark, that some indefiniteness
must be admitted as to the existence or not of an ascending or
descending meso-colon. A collapsed gut may have a well-
marked meso-colon, when a distended gut would have none. As
the bowel empties, the peritoneal layers fall together behind it;
while, as it is filled, they are pushed apart, and the intestine
becomes sessile. It will be found that a dilating colon borrows
more of its investing peritoneum from behind, where the areolar
tissue is lax, than from the front, where it is more firmly
adherent.

The left meso-colon is usually attached along the outer border
of the kidney, and is vertical. The right meso-colon is not quite
vertical, but "crosses the lower end of the kidney from right to
left, and then ascends along the inner border of the gland "
(Treves).

In surgical operations on the intestines, it is impossible to
ignore the great omentum. Rarely is it found conforming to the
anatomical descriptions of it—spread out like an apron over the
bowels. In many cases it is never seen, being placed high up,
coiled or folded upon itself. In other cases it lies entirely on one
side of the abdomen, usually the left. It may be twisted up like
a rope, or spread out in one part and contracted in another;
frequently it is adherent to bowel or parietes; sometimes it is

partly imbedded among the intestines. It may be thin and translucent or even cribriform, or it may be very thick and laden with fat.

The free anastomosis of the intestinal vessels in the peritoneum has as much surgical significance on the one hand, as their circular distribution in the intestinal wall has on the other. Thus, though a piece of mesentery may be destroyed at a little distance from the bowel without impairing its vitality, the smallest portion of bowel left without its mesentery closely attached to it may, and probably will, die.

A word must be said on the sigmoid flexure of the colon. Treves has shown that the curve which this part of the bowel describes is more of the shape of the Greek Ω than the letter S. This omega-flexure has a well-marked mesentery. It usually lies wholly in the pelvis. When distended it rises out of the pelvis, reaching sometimes as high as the umbilicus, and, in cases of extreme distension, even to the liver. In this condition it is liable to become twisted upon itself, producing volvulus. Its more exact disposition does not here specially concern us.

As bearing upon all operations on the intestines, and especially on resection and suture, the anatomical structure of the intestinal coats and the mode of attachment of the tube to the mesentery are of supreme importance. The following statements are based upon the elaborate studies of William S. Halsted of New York;[*] also upon notes by Mr. Anderson of St. Thomas's Hospital,[†] and upon some observations made by myself. As they, in some respects, modify or contradict generally accepted views, they must be given with some degree of fulness.

Firstly, as to the structure of the internal coats. Fig. 124 is copied from Halsted's paper. It "is a diagram of the dog's intestine, and is intended to represent accurately the thickness of the several coats. The serosa is prolonged beyond the outer muscular coat to emphasise its thinness. Between the submucosa and the glands of Lieberkühn—in other words, between it and the lumen of the intestine—practically nothing intervenes;

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[*] *Internat. Journ. Med. Sc.*, Oct. 1887.
[†] MacCormac's *Abdominal Section*, 1887, p. 25.

and, literally, nothing but the two layers of muscularis mucosæ and fibrosa mucosæ respectively. Fully two-thirds of the thickness of the wall of the intestine is mucous membrane. When the needle, therefore, has been passed through its outer third it must have entered the glands of Lieberkühn, and, hence, the lumen of the gut. It is an easy matter to isolate the sub-mucosa. The outer muscular coats strip from it readily, and the mucous membrane can be rapidly scraped off with a knife. Thus obtained, the sub-mucosa is found to be an exceedingly tough fibrous membrane. It is air-tight and water-tight, and is the ' skin ' in which sausage-meat is stuffed. It is, moreover, the coat of the intestine from which ' catgut ' is made.

" A needle, on being pushed vertically through the walls of the intestine, meets with considerable resistance when it reaches the sub-mucosa, and still greater resistance is encountered if it be attempted to pass the needle horizontally through its meshes. A delicate thread of this tissue is very much stronger and better able to hold a stitch than a coarse shred of the entire thickness of the muscular and serous coats."
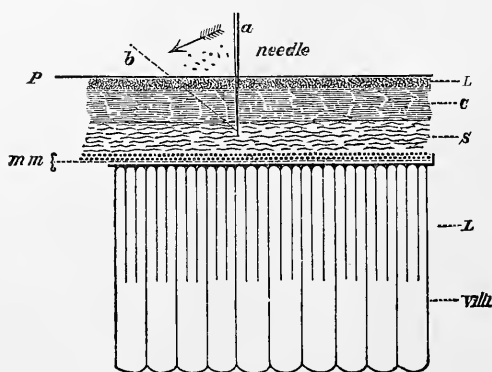
FIG. 124.

Diagram of Section of Dog's Intestine.

P, Peritoneum; L, Longitudinal Muscular Coat; C, Circular Muscular Coat; S, Sub-mucosa; mm, Muscularis mucosæ; L, Glands of Lieberkühn.

Practical experiments to test this point bore out these views. Halsted " soon discovered that, even to the sharpened end of a needle, sufficient resistance is offered by the sub-mucosa to be readily appreciable, and that it is possible and, with very little practice, not difficult to pick up at each stitch a thread-like piece of sub-mucosa without incurring the danger of passing into the lumen of the gut."

Practical advantage of the toughness of this sub-mucosa may further be taken by picking up portions of it in stitches, carefully placed so as to pierce it some distance apart, and making traction on the sutures. This raises a ridge on the serous aspect of the gut, which at once marks the line in which the co-aptating sutures should be placed, and by raising the tissue to the needle, greatly facilitates the introduction of the individual sutures. I have endeavoured to show this in the diagrams accompanying the description of enterorraphy. (Figs. 129 and 142.)

As to the disposition of the mesentery around the gut, we must not forget that it is not a complete envelope, but leaves a portion of the lumen, averaging about five-sixteenths of an inch in width (Anderson), for which the outer covering is the muscular. The divergence of the layers of mesentery begins at a distance varying from two-thirds to three-fourths of an inch from the wall of the gut, and we thus get a triangular space, filled with fat, intestinal vessels and lymphatics, bounded by mesentery on two sides and bowel on the third. The arterial loops to supply the intestines lying in this space come to within a third of an inch of the gut, closer in the lower portion of the ileum than in the jejunum. From these loops are given off the straight vessels, which pass directly, on each side of the interspace, to supply the bowel. It is evident that the anastomosing loops should be injured as little as possible, if the vitality of the bowel is to be assured; triangular resection of the mesentery should therefore be, as far as possible, avoided. The layers of the mesentery at their attachment to the bowel are very lax and easily drawn together by purse-string sutures, so that they need not be in the way, even if they are left behind; while, as will be pointed out further on, they may be employed to give breadth and solidity to the intestinal union at a point where it has been found that it most frequently gives way.

Resection of Intestine.

Enterectomy ; Colectomy ; Cæcectomy.

History.
Conditions for which Operation may be performed.
    Gangrene.
    Tumours, simple and malignant.
    Wounds.
    Artificial Anus.
    Intussusception.
    Peritoneal Adhesions (?)
    Simple Stricture (?)
Indications and Contra-Indications.
Mortality.
The Operation Described.
    Instruments.
    Parietal Incision.
    Delivery and Isolation of Bowel.
    Resection of Bowel.
    Enterorraphy.
        Classification of Methods.
        Sutures and Methods of Suturing.
        Accessory Apparatus.
        Methods Described.
            End-to-end Enterorraphy by Suture.
            End-to-end Suture by Maunsell's Method.
            End-to-end Junction by Murphy's Button.
            End-to-end Junction by Absorbable Cylinder.
            End-to-side Junction by Suture and by Cylinder.
            Lateral Approximation by Suture and by Bone Plates.
        Selection of Method.
    Enterectomy in Three Stages.
After-treatment.

Removal of a piece of small intestine is known as enterectomy;
the same operation applied to the large intestine is called colec-
tomy. Cæcectomy, or excision of the cæcum, usually involves
the removal of part of the ileum and part of the ascending
colon as well. The operations may be considered conjointly.

History.—It would seem that this is by no means a novel
proceeding. According to Dr. E. J. Ill,* Ramdohr, in 1727,
successfully removed two feet of gangrenous intestine from a
hernia. Up to 1836, the same writer tells us, the operation had
been performed at least ten times by French, German, and
English surgeons. Of these cases 5 were cured, 2 were left
with artificial anus, and 3 died. Such operations, however,
were rather timorous removals of sloughs, than deliberate
resections of bowel. Such a case is one where Mr. Cookesley,†
a surgeon of Crediton, in 1731, removed six inches of gangrenous
bowel in a case of strangulated hernia, and the patient completely
recovered.‡

* *New York Med. Rec.*, Sept. 22nd, 1883.

† *Med. Essays and Observations*, Edinburgh, 1752, p. 357.

‡ The following interesting record is from Cheselden's *Anatomy*, Lond.
1730, p. 151 :—

"Thomas Brayn of Yeaton, in the parish of Baschurch, and county of
Salop, a doctor for cattle, maketh oath, that about ten or twelve years agone,
he was sent for by a farmer or husbandman, who lived near the village called
Maesbrooks, and very near to the river Verney, in the said county of Salop,
to have his advice about an ox he had, which was then sick by reason he
could not dung : he had been drenched by several beast doctors before this
deponent came to him. This deponent seeing this ox in the condition he was
in, told the owner, that if he would venture his ox, he would do him what
service he could, in the curing of him ; which the owner consented to, and
thereupon this deponent opened the ox in the flank, and took great part of his
bowels, upon searching which he found there was a perfect stoppage in the
guts ; and the gut was about the stoppage putrified for about three-quarters
of a yard, whereupon this deponent cut off so much of the gut as was
putrified, and took it quite away, and then drew the ends of the guts which
remained sound after what was cut off, together upon a hollow keck, which
was about three or four inches long, and sewed the said ends of the guts
together upon the said keck, leaving the keck within the guts, and then
sewed up the hole cut in the hide upon the flank of the said ox ; and this
deponent further saith, that within the space of one hour after this operation
was performed, the ox dunged ; and the piece of the keck which the said
ends of the gut were sewn upon and left within the guts, came away from
the ox with the dung, whereupon the ox recovered, and lived to do the
owner service several years."

The removal of a diseased portion of colon was first suggested by Littré in 1710 ; but it was not till 1833 that the first operation was performed.   According to Marshall,* Reybard of Lyons, who made claim to having performed the first colectomy, presented his paper to the French Academy of Medicine in 1844 ; but it was rejected for publication in the *Memoirs* of that body, on account of some want of definiteness in the record.   It seems almost certain, however, that he did excise a tumour from the sigmoid flexure, along with some portion of bowel ; that he sutured and returned the divided gut ; and that the patient lived for ten months afterwards, passing fæces per anum.   The next operation is credited to Gussenbauer of Liège in 1877.   In his case, a primary median incision was supplemented by a transverse one : his patient died in 15 hours.   In 1879 he attempted another operation, but had to finish it as a lumbar colotomy. In 1878 Baum of Dantzic supplemented a vertical incision for enterectomy by a transverse one, and removed a growth in the ascending colon, with some inches of bowel above and below. Fæces escaped through the wound, and the patient died on the seventh day.   In 1879 Martin of Hamburg had a brilliant success after a most difficult operation, in which he removed a large growth with a portion of the sigmoid flexure and some glands.   In 1880 Czerny had a partial success after a difficult operation, the patient dying seven months afterwards from a recurrence of the disease.   In 1881 Bryant finished a lumbar colotomy by removing the diseased bowel ; and in 1882 Marshall unsuccessfully removed a growth from the descending colon by lumbar incision, after having failed by median section.   Since then a number of cases have been recorded.

Resection of the intestine did not, however, assume the position of a recognised operation till 1875, when Langenbeck revived it, to be followed in 1877 by Küster.   Since then the proceeding has made rapid strides in public estimation, and is now regarded as one of the most successful of heroic operations.

* *Lancet*, May 13th, 1882.

Conditions for which Entcrectomy may be performed. Indications and Contra-Indications. Mortality. Resection of bowel may be performed for gangrene, for tumours of the bowels, simple or malignant, for extensive wounds and injuries, for some cases of artificial anus and of irreducible intussusception, and in a few cases of obstruction from cicatricial adhesions and from simple stricture.

Gangrene is usually associated with some form of obstruction of the bowels caused by internal or external strangulation. In this case resection is simply a termination to an operation designed to relieve the obstruction. The extent of gangrene will vary from a small knuckle of bowel involving only part of the calibre of the gut to several inches, or even feet, of the whole intestine. The necrosis may be complete throughout, and separated sharply from the living bowel by a line of demarcation; or while complete at one point, it may merge into extreme congestion, and have no definite limit, at another.

McCosh* has collected and tabulated 115 cases of resection of gangrenous strangulated intestine where immediate suture was carried out. Of these, one-half recovered. With the help of the Murphy button, 26 enterectomies gave only three deaths. A collection of cases noted by the writer during the past four years, and including about 60 operations, gives a mortality of just over 30 per cent. For all cases by all methods the death-rate is probably about one in three.

The indications for resection of gangrenous bowel would vary according to the condition of the patient, the extent of the gangrene, and the condition of the bowel immediately beyond it. Complete necrosis not extending beyond inches with fairly healthy bowel beyond may, if the patient is not very ill, be always treated by resection and junction of the divided ends. At the other extreme, a very extensive area of gangrene, or an imperfect limitation of it with unhealthy bowel beyond, and a patient very ill, would best be treated by operation in two stages, with formation of temporary artificial anus. Many doubtful cases lie between,

* *N. Y. Med. Journ.*, March 16, 1889.

in which the surgeon must follow his good judgment.   Completely necrosed bowel is practically already resected : it may usually be removed to advantage.   The doubt arises mainly as to the closure. If the gangrene is so high up in the small bowel that the formation of fistula would induce starvation, closure must be made at all costs.   Here one of the time-saving expedients to be described will be of conspicuous benefit.

The operation may have to be done for internal obstruction through a cœliotomy incision, or for external hernia at one of the ordinary sites.   The hernia incision may have to be enlarged upwards, or if there is tension on the mesentery a fresh incision high up may provide the greatest facility for delivering the bowel and performing the operation.

Tumours of the bowel, simple or malignant, call for removal usually because they cause some form of obstruction.   They are often spoken of as stricture, simple or malignant.   It is certainly the case that the narrowing caused by the tumour is the most frequent cause for operation ; but it is advisable to keep the term stricture for cases of simple cicatricial stenosis, however induced, but not associated with tumour.

In all cases of tumour, simple or malignant, resection is practically the only means of cure.   This resection may involve the whole bowel for several inches, or only, in non-malignant cases, the portion of intestine to which the tumour is attached. Tumours with pedicles, may be removed without taking away any piece of the outer intestinal walls.

Cancerous growths are found almost uniformly in the large intestine.   Of 35 cases of resection of cancerous bowel tabulated by Weir,* all save one involved the large bowel.   Butlin,† after a critical examination of Weir's cases, eliminates two in which the operation was incomplete.   To the 33 remaining he has added 4 ; of this total of 37, 32 were of the large intestine, 3 of the small intestine, and 2 uncertain.   The parts of large intestine involved were : cæcum, 7 ;   ascending colon, 4 ;   transverse colon, 3 ; descending colon, 7 ;   sigmoid flexure, 9 ;   "colon," 2.

* *N. Y. Med. Journ.*, Feb. 13, 1886.   † *Operat. Surg. of Malig. Dis.*, p. 231.

Epithelioma attacking primarily the mucous membrane is the variety of malignant growth which is most common. Its chief peculiarity is the extreme degree of stenosis which it causes, even when the amount of new tissue is small. There is always hypertrophy of the muscular coats immediately round the growth, and some thickening, often considerable, of the sub-mucosa where it is not ulcerated. In the centre or at one side of this thickened mass a small tortuous canal, frequently not large enough to admit a crow-quill, represents the intestinal canal. Above the growth the intestine becomes dilated and hypertrophied, often to an enormous extent. When a wave of intestinal contraction passes on towards the obstruction, the hollow muscle in full contraction stands out erect around its contents, which it seems to grip like a fist, being often visible and easily palpable. These ineffectual contractions, as the obstruction gets more complete, recur with increasing frequency and violence, accompanied with loud gurglings, and are the cause of much pain to the patient. The symptoms in fact are usually all from the stricture. In a few cases, and more especially in the transverse colon which lies on the surface of the abdomen, a tumour may be palpated. The tendency of such growths to invade the surrounding fat everywhere in the colon is most marked in the transverse colon, where fat is more abundant, and here accordingly the tumour is usually largest.

The mortality after resection of cancerous intestine is somewhere about 40 per cent. Weir's statistics of 33 cases of completed resection give a mortality of 51.5 per cent. Kendal Franks * collected 51 cases of colectomy for cancer, in which the mortality was 40.8 per cent. With the Murphy button 30 operations gave 7 deaths, a per-centage mortality of 23.3. Small groups of cases in the past few years give an improved mortality. The writer can speak of only six cases with four recoveries. Mayo Robson has had excellent results with his bone-bobbin. A tabulation of recent cases might bring the mortality under 40 per cent., but probably over 30 per cent., if all cases were included.

Non - malignant growths, fibromata and myxo - fibromata,

* *Brit. Med. Journ.*, Mar. 2, 1889.

usually are very rare. I have seen no complete statistics of the mortality following their removal. The operation, however, should be more successful than for malignant disease. There is no case recorded in Murphy's table of removal of a non-malignant growth. Recently,[*] I successfully removed a non-malignant growth at the apex of an intussusceptum, using the Murphy button to join the intestines.

For extensive *wounds* or other injuries caused by crushing or by penetrating or gunshot wounds resection may be the best treatment. This will be considered fully in the special section devoted to injuries of the abdomen, and will not be further referred to here.

So also, for *artificial anus* and *intussusception* the special treatment by resection of intestine will be discussed in another place.

It may occasionally happen that, in cases of obstruction from *peritoneal adhesions*, it is impossible to disentangle the coils. In such cases the choice lies between enterotomy as a palliative, and resection or intestinal anastomosis as a means of cure. Koeberlé[†] on one occasion did not hesitate to resect more than six feet of small bowel entangled in adhesions. At the present day resection would scarcely be contemplated, but rather intestinal anastomosis or junction of the free bowel above with the free bowel below by approximation, and so excluding the adherent coils and permitting them to atrophy.

For *Simple Stricture* entero-plasty would now, where at all possible, be preferred to enterectomy. This operation is done on the same lines as pyloro-plasty; and would, I think, be best done by the help of a bone cylinder. A good many cases of enterectomy for simple stricture are recorded; but as the operation will rarely be performed in the future, statistics need not be quoted.

The modes of death may be deduced from the most generalised statistics. Reichel[‡] in 120 cases of resection with suture of the divided ends gives as results 58 deaths, 58 cures, and 5 with

* *Lancet*, vol. ii., 1895.   † *Mem. de la Soc. de Chir. de Paris*, 1889, p. 99.
‡ *Deutsche Zeitschrift f. Chir.*, 1883, p. 320.

fæcal fistulæ. Ill collected 47 cases with 25 deaths. The most frequent cause of death was peritonitis, started by some defect in the operation ; more than one-half of the deaths were so caused. The best results after resection were got, as might have been expected, after the operation for artificial anus. From the elaborate tables of Makins,* which give many valuable facts for which I have not here space, we gather that of 39 cases of resection for artificial anus, 15 died, 3 were left uncured, and the rest—21—were cured. By Murphy's method 9 operations for artificial anus were all cured. Resection for artificial anus is, in my opinion, rarely necessary ; with the mortality shown in Makins's table, I doubt if it is justifiable.

The serious and important question of resection of cancerous growths during obstruction of the intestines will be separately and fully discussed further on. Here no more need be said than that although I advocate resection, I would advise its being done in stages after fixation of the growth outside the parietes and drainage of the obstructed bowels.

THE OPERATION.

Instruments.—The instruments and their use will be described as the steps of the operation for which they are employed are explained. Here it will be convenient to give a list wherewith the operation may be performed :—

　1 Scalpel for parietal incision.
　1 Scalpel with thin and long blade for incising bowel by transfixion.
　12 Catch-forceps — peritoneal forceps with fine points (Author's) most suitable.
　1 Scissors with long blades and blunt points.
　1 Scissors with sharp points.
　4 Intestinal clamps (Lane's).
　　Set of Murphy's buttons.
　　Set of decalcified bone cylinders or bobbins.

* *St. Thomas's Hosp. Rep.*, xiii., 1884, p. 81.

Set of Senn's plates, threaded.

12 Intestinal needles, with silk, catgut and silk-worm gut ; gutta-percha tissue to cover extruded bowels; sponge-cloths; flat and round sponges ; and other operation accessories and dressings.

Parietal Incision.—This should always be made, if possible, directly over the portion of intestine to be removed or above it. Thus is the greatest possible extrusion of intestine permitted. As the intestines hang downwards, an incision directly over the mesenteric attachment will, in most cases, give the greatest facility in bringing the bowel outside ; this incision, for the small bowel, would be above the situation of the part to be removed. For the large bowel the incision should be made over the seat of disease, on the left side for the descending colon, on the right for the ascending colon and cæcum, and in the middle line for the transverse colon.   For the small bowel the incision should never be much below the umbilicus, and in most cases would preferably be above it.   In cases of gangrene in a femoral or inguinal hernia the primary incision is fixed at the seat of the hernia ; a secondary incision, if necessary, can scarcely be too high up.

For excision of the cæcum the best incision is probably an oblique one in the costo-iliac space rather to the outside of, than over, the part to be removed. An incision in the linea semi-lunaris is some way from the work, passes through several coils of small bowel, and gives only a little space and light for the important steps of excision of the bowel from its meso-colon. An incision along the line leading from the anterior superior iliac spine upwards towards the costo-spinal angle lies to the outside of the bowel mostly, gets directly down to the bowel and exposes the meso-colon on the outside, where it can be seen ree from intruding small bowel.

As the meso-colon in cases of tumour is usually shortened, the importance of direct access to the work is self-evident.   The mesentery of the small intestine in the cases requiring resection (those of gangrene usually) is likely to be lengthened.

The incision for resection of the descending colon should be

more vertical, but still a little to the outside. The sigmoid flexure has a long mesentery, and any part of it may usually be pulled through a central incision below the umbilicus. But here, also, a little deviation towards the mesenteric attachment on the left will be advisable.

So far as is possible the principles already discussed (p. 97) as to the making of the parietal incision should be followed. But this is one of the grave operations where everything must give way to the increasing of the facility of the operation, and a free incision passing through everything regardless of muscular or fascial fibres would be perfectly justifiable in nearly every case.

The first part of the incision should not be longer than two inches ; through this the growth is examined, and the possibility of its removal is decided upon. The incision is then prolonged upwards or downwards, or across, as seems best for the satisfactory removal of the gut.

Delivery and Isolation of the Part to be Resected.—In every case the bowel to be operated upon should be brought through the parietal incision and isolated from the cavity, as much as possible, by packing sponge-cloths or flat sponges around it. To prevent irritation of the peritoneal surfaces and evaporation, fine gutta-percha tissue should be placed directly over the bowel which is not to be removed. The sponge-cloths should be wrung out of hot antiseptic or sterilised fluid, and should be changed as soon as they cool.

If there is any difficulty in bringing the bowel outside, traction should be made on the mesentery and not on the bowel. And if traction on the mesentery does not suffice, a transverse division of it after ligation under the part to be resected may be made, although this is best done later. In every case it is necessary to make a full and particular examination of the diseased part before proceeding to remove it.

In the case of gangrenous bowel protruding through a hernial opening, gentle traction is employed to bring healthy bowel into view, and to make certain that the healthy portion can be brought far enough outside to permit of its being resected

and sutured. If simple traction will not suffice, on account of the smallness of the opening, or the presence of adhesions, or great distension of the abdominal portion of gut, then the simple herniotomy must be enlarged into cœliotomy, or a new incision must be made. When the gangrenous bowel lies inside the abdominal cavity, we must carefully examine and see that the healthy bowel beyond the gangrene is free and sufficiently movable to be brought to the surface.

In the case of malignant disease, not only are the upward and downward limits to be accurately noted, but the mesenteric folds in the neighbourhood must be explored to make sure that the glands are healthy. One or two glands in the area of mesentery attached to the bowel may be removed, and this need not contra-indicate operation; but if glands are infected beyond this area, the operation must be abandoned. Adhesions to neighbouring bowel, if firm and well organised, ought, in my opinion, to contra-indicate resection.

In artificial anus, the mode of isolating the bowel is somewhat peculiar; and this, coupled with other peculiarities, will render necessary a special description.

As accessories in the isolation of the gut *intestinal clamps* may be employed. The best clamps, so far as the bowel is concerned, are the fingers of a skilled assistant; but these occupy much room and get tired, so the employment of instruments is advisable.

The best clamp yet devised for the intestines is, in my opinion, that of Arbuthnot Lane (Fig. 125). It consists of a simple steel rod, which is pushed through the mesentery under the bowel, and a loop of india-rubber fixed in a slot at one end of the rod, and to a cap at the other end, which is placed

FIG. 125.

Lane's Intestinal Clamp.

over the end of the rod. This clamp occupies very little room, it cannot slip, it may be applied and removed very

quickly, and it is quite efficient. I have modified it a little (Fig. 126), so that the rubber can be tightened at will, and so that a more distinct flexure of the gut is made at the seat of clamping.

An excellent clamp is that of my friend and colleague, Dr. James Swain (Fig. 127). In it an equality of pressure is maintained along the whole length of the blades; it can be very quickly applied and it occupies little room.

Another good clamp, which has done me good service, is that of Makins (Fig. 128). It is made on the principle of Dieffenbach's spring catch-forceps, with the addition of a screw, and has blades long enough to compress the whole bowel; while it may be applied without perforating the mesentery, and the blades are covered with rubber tubing to minimise the risk of injury to the gut.

FIG. 126.

Author's Modification of Lane's Intestinal Clamp. Full size.
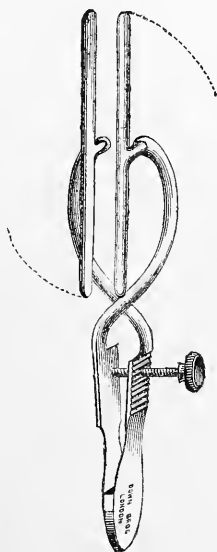
FIG. 127.

Dr. James Swain's Intestinal Clamp.

Other clamps have been invented, amongst which the best known are those of Treves, Bishop, and Abbe. If no clamp is available, an efficient one may be extemporised by folding a flat sponge round the bowel and tying a ligature over it, after perforating the mesentery.

Before applying the clamp all intestinal contents should be pressed downwards and upwards, so that the area of operation shall be collapsed and empty. If there is

intestinal distension from an accumulation above the seat of operation, it may be wise to spend a few·moments in letting this drain away through the incised bowel before the clamp is placed in position. If there is much distension this practice should never be neglected.

Two clamps are sufficient, each being placed at a distance of at least two inches away from the line of resection. The intestine outside the cavity is completely isolated from the general cavity by means of sponge-cloths or sponges packed closely around the gut on the parietes. The clamps resting on the parietes at the ends of the parietal incision prevent the bowel from being drawn into the abdomen. Some surgeons use four clamps, one being placed on each side of the lines of incision, and the bowel being divided between each pair. If the bowel is completely emptied between them, two clamps suffice.

Resection of Bowel.—The gut may be removed either with a triangular piece of mesentery or along the mesenteric border. To remove a wedge-shaped piece of mesentery, and stitch up the divided margins, gives a surgical finish to the operation which, I think, is of apparent rather than of real value. It involves less division of vessels, and so induces a smaller risk of subsequent gangrene, to leave as much mesentery as possible. The mesentery may be gathered together in a continuous suture under the line of intestinal junction ; and if a few superficial sutures are placed between the broad base so formed and the intestinal walls, it affords increased breadth and security of apposition. Especial care must be taken that no portion of bowel be left without attached mesentery. In experiments on animals, Rydygier and Madelung showed that gangrene was liable to occur in pieces of

FIG. 128.

Makins's Intestinal Clamp.

bowel protruding beyond the mesenteric attachment. Zesas,[*] continuing and extending these experiments, found that gangrene always followed separation of the mesentery close to the undivided bowel, but that no such result followed when the separation was made at a distance.

If the bowel is much congested, bleeding from the divided vessels is likely to be rather sharp. The use of a blunt scissors will lessen this. Forci-pressure must be used with discretion; the intestinal walls must not be crushed—only the bleeding point must be seized. The writer's sharp-pointed peritoneal forceps are the best for this purpose.

If a triangular area of mesentery is removed, the gap must be carefully closed by suture. A good method of suturing is the continuous overlapping or over-edging stitch, applied over the cut ends while the peritoneal planes are held in apposition by the fingers. A double row of continuous sutures, in reversed order, will give additional security. Catgut would be quite efficient. Treves lays particular stress on the accurate suturing of the mesenteric gap, so as to prevent occlusion by kinking at the line of junction. For the same purpose, and also to minimise the risk of gangrene at the free edge of the bowel, MacCormac recommends an oblique division of the gut, more being removed from the free than from the mesenteric side. Murphy also advises that this should be done; and surgeons generally follow the practice now.

Resection of the cæcum may have to be done without complete delivery of the bowel. The advantage of the parietal incision to the outside of it will then be evident. Here division beginning at the bottom of the meso-colon and going as high up as may be necessary, may be associated with the insertion of a continuous purse-string suture, or a series of transfixing sutures, to check the bleeding. There is no mesenteric gap to be closed. The mesentery at the ileo-colic junction may most conveniently be dealt with after division of the colon above the disease, when the bowel may be delivered. Four clamps, a pair on each side of the lines of division, will be advisable here,

* *Arch. f. Klin. Chir.*, 1886, Bd. xxxiii., Heft 2.

because of the difficulty of completely emptying the bowel of its contents.

Resection of the transverse colon requires a threefold division; of its meso-colon, of the gastro-colic folds of the omentum, and of the great omentum.   Each division should be made after gathering the loose tissues into one or more interlocking ligatures placed by blunt pedicle forceps.

The intestine is divided by one clean cut with the large blunt-pointed scissors.   In the division care should be taken that the two sides are cut evenly, that more bowel is removed at the free border than at the mesenteric junction, and that no mesenteric vessel close to the bowel is injured.

ENTERORRAPHY.

Of modes of performing Enterorraphy there is a variety which seems almost without limit.   Bishop, in a valuable paper on Enterorraphy,* was able, ten years ago, to collect no fewer than 33 distinct methods.   Since then at least 30 more methods, or variations of methods, have been introduced.   Some of these are simply fantastic; others fail to fulfil the demands of sound pathology in some detail or other ; and many have become obsolete simply from disuse ; but not a few of the methods are brought forward with the authority of great names, and at least half-a-dozen are stamped with the imprimatur of success.

It may be of advantage here to consider some of the leading principles which should guide us in selecting a method,—in other words, to inquire how and to what extent practical methods may be made to harmonise with the pathological processes involved.

Almost universally union has been aimed at through coaptation of serous surfaces.   Obvious reasons are, that the thinness of the bowel provides too little surface for end-to-end apposition of the cut surfaces, and that to turn the mucous surface out would, of course, be useless.   So the serous surfaces are turned in.   Alternative plans would be, to strip the mucous surface some little way from the division and unite by outfolding ; or to split

* *Med. Chronicle*, Sept., 1885.

the ends separating musculature from mucosa, and make end-to-end junction by a flange-stitch. As to the junction by sero-serous adhesion, there is no doubt that it takes place rapidly and that it provides abundant material to prevent leakage, but it is not strong in the sense of resisting traction. The uniting medium is in the first place composed only of plastic lymph and leucocytes and cells derived from endothelial proliferation, and as this medium rests on the smooth membrane, it has little binding power. Also, being shut off from the true areolar tissues by the sub-endothelial membrane, it is late in becoming vascularised and provided with fibrous tissue. To scratch the serous surfaces is undoubtedly to help in opening up the fibrous planes under the serosa, but unfortunately it results at the same time in the production of a still greater excess of non-cohesive temporary uniting material. The uniting material is temporary of course, but it is too long temporary. It can be detached with the greatest ease after three days, and without much difficulty in a week; and, to prove that vascularisation is still very imperfect, almost no bleeding takes place on the detachment being made.

Now junction of fully rawed surfaces, where the fibrous layers are opened up and brought together, provides firmer temporary union, and more rapid permanent union. The permanent fibres in the tissue entangle and hold the lymph; plasma cells are present in abundance, and the formation of vessels is much more rapid. Such union is firm at the end of a few hours, and is not separated without the employment of considerable force at the end of two days, when it bleeds freely, showing that vascular formation is already well advanced.

On the ground of providing the best, because the strongest and quickest, mode of union, the apposition of rawed surfaces is the best. The objections to the employment of this method are entirely practical. To get it we should have to detach a ring of mucous membrane all round, and evert the rawed musculature with such fibrous tissue as was not carried away by the mucosa; or we should have to strip the serosa in a ring all round, or after opening up the junction of the mucous and muscular coats we might unite by a flange-stitch. Theoretically, the last is the best;

but practically, it is perhaps the most difficult. With a thick bowel and a possibility of separating the coats without cutting, the method by flange-stitch may be adopted with confidence. But with bowel of the ordinary thickness, and the coats as closely adherent as they usually are, separation of the coats even with the undesirable use of the knife would be a proceeding of great difficulty. Therefore, union by flange-stitch, although perhaps the method of election on theoretical, is usually forbidden on practical grounds. To strip and remove a ring of mucosa at each end of the divided bowel, and join the outfolded and rawed fibro-muscular coats, would give excellent pathological union ; but would introduce practical dangers and involve waste of tissue. For the mucous membrane might be turned in and help to form a plug, instead of being removed. And to perforate the outfolded flaps for sutures would be to risk leakage. If at the angle where the mucosa and musculature were separated a buried row of sutures or a continuous buried suture is inserted, we have the flange-stitch ; and if to this is superadded an outside perforating suture joining the lips, we should have a perfect method of junction. Here again practical objections intervene. Such a mode of union would require very dexterous fingers, and must always occupy considerable time. Lastly, to strip a ring of serosa from the ends of the bowel and turn the margins in may be adopted. But this is not easy to do ; it takes some time, and it causes bleeding which is long in stopping. Also it often means the wounding of important blood-vessels.

Another and most important fact is that of unrest in the parts to be united. The contractions of the intestines disturb the uniting medium, and tend to create gaps between the sutured points. To prevent this intestinal contraction, and to act in some sense as splints, hollow cylinders have been employed from the earliest times, and have recently been revived. The objections to these are, that being foreign bodies they cause intestinal worry with secretion of mucus, and enteritis ; they do not prevent the muscles from contracting, though they prevent the intestine from closing, and herein perhaps they succeed in setting up further irritation. But they secure the grand fact of physical rest in the

sutured wound, and for this alone their use will always have supporters.

To these cylinders have been added means for assisting the junction of the divided bowel, or even for combining both purposes. The Murphy button—the most perfect development of this plan—combines the suture with the splint. Bone cylinders with flanges and movable discs seek the same end, but do not dispense with the suture. Most of these tubes act by infolding of the serosa ; but in some this is combined with stripping of the mucosa, and in several there is produced actual invagination of the intestinal coats.

What has been said relates simply to the actual junction of the lines of apposition. Further considerations arise in connection with the manner in which the apposition is made. Here again we have a variety of methods all of which may be classified under three heads : (1) End-to-end, (2) Side-to-side, and (3) End-to-side apposition.

It has been proved that so far as the restoration of function is concerned it matters little how the divided intestines are joined as regards their axes ; that is to say, whether end to end, side to side, or end to side. The question is almost entirely a practical one. Perhaps in the junction of small to large intestine, end-to-side approximation has the extra approval that would be given to an imitation of the natural junction ; but side-to-side junction is quite an artificial creation, having no place in nature. In any case the chief reasons for adopting any one method of approximation relate to the operation itself, and are : firstly, ease and rapidity of performance ; and secondly, perfection of closure.

Another argument has been based on the occurrence of gangrene along the lines of junction, this being most liable to occur in circular end-to-end enterorraphy, and least liable to occur in the side-to-side operation. This argument is not a strong one, gangrene being rare if the operation is properly performed, and therefore it will not be dwelt upon.

The methods in vogue may be conveniently classified as follows :—

Enterorraphy.

END-TO-END.		END-TO-SIDE.		SIDE-TO-SIDE.	
DIRECT.	MEDIATE.	DIRECT.	MEDIATE.	DIRECT.	MEDIATE.
Czerny-Lembert.	*Bone Bobbins* (Robson).	Jessett.	*Bone Bobbins.*	Wölffler.	*Bone Plates* (Senn).
Bishop.	*Bone Tubes* (Paul)	Maunsell.	*Murphy Button.*	Abbe.	*Hide Plates* (Robinson).
Halsted.	(Jessett)		*Rubber Ring.*	Halsted.	*Rubber Plates* (Robinson).
Maunsell.	(Robinson).		*Catgut Ring.*	Barker.	*Bone Plate with Cylinder* (Jessett).
Jobert.	*Metal Button* (Murphy).		*Bone Plate and Cylinder.*		*Metal Cylinder* (Murphy).
	Catgut Rings (Brokaw) (Senn).				*Plates of Turnip, Potato, &c.*
	Tubes of Turnip, Potato, &c.				

Under the various heads some of the best known methods are named. "End-to-side" is usually spoken of as "implantation," and "side-to-side" as "approximation." "Mediate" refers to the use of apparatus in addition to sutures. It is not a very good word, but no better suggests itself.

The headings given in the table may be conveniently used to name the method; thus "mediate end-to-end enterorraphy," or "direct side-to-side enterorraphy," will sufficiently name the method employed, while the variety will be described by the name of the introducer.

It is quite impossible to describe all these methods in detail; and, with our present knowledge, it is impossible to pick out any one as being under all circumstances the best. We cannot afford to cast aside any method named; for, under special circumstances, parts of one method may be adopted and joined

to parts of another method. The plan adopted in the following pages is—

(1) To describe a few of the best sutures applicable to all methods.

(2) To describe the apparatus employed in mediate union, and,

(3) To describe in detail two or three of the methods which, in the writer's opinion, are the best for each plan of operation.

Sutures and Methods of Suturing.—The essentials of any *suture material* for employment in closing wounds of the intestine are, that it shall be flexible, unirritating, remain unchanged for at least three weeks in the tissues, and be absolutely aseptic. Fine silk threads of the variety known as Chinese twist is almost universally recognised as best fulfilling these requisites. Catgut swells and is absorbed too quickly, or if chromicised or otherwise hardened to make it more durable, it is not sufficiently pliable. Silkworm gut, if very thin, answers well ; but it is liable to cut its way through the tissues, and its cut ends stand out and scratch neighbouring tissues. To prevent this possibility of cutting through the tissues, bulk is as important as strength in the suture material. With this view floss silk may be used ; but its loose fibres favour capillary attraction of fluids along the suture holes, a result to be avoided. Carefully prepared Chinese twist, of the three smallest sizes made, supplies in the best form the suture material requisite for every variety of enterorraphy.

The *needles* employed should be round, with no cutting edge and not too sharp in the points. They should be fine enough easily to pass through the tissues, and blunt enough to push a vessel to one side rather than to pierce it. Further, a moderately blunt needle is caught by the thick fibrous submucosa, and warns us of the safe limit for transfixion. Ordinary straight milliner's sewing needles, about two inches in length, make the best intestinal needles. Their points, if too sharp, are blunted a little by being rotated a few times on a stone or steel while the shaft is held upright between the finger and thumb. At least

one dozen of such needles should be in readiness.   Curved needles I have entirely discarded as being difficult to handle, and having no advantage over straight needles.

The needle should be inserted so as to give the suture the strongest possible hold of tissue.   This is best done by pushing the needle straight down to its full depth till it meets the fibrous layer, then tilting it and pushing it along some way, and bringing it out by sharply bending the bowel over it. Halsted first pointed out the importance of catching up a few fibres of the submucosa to give holding power to the suture : to pick up many fibres by pushing the needle along the line
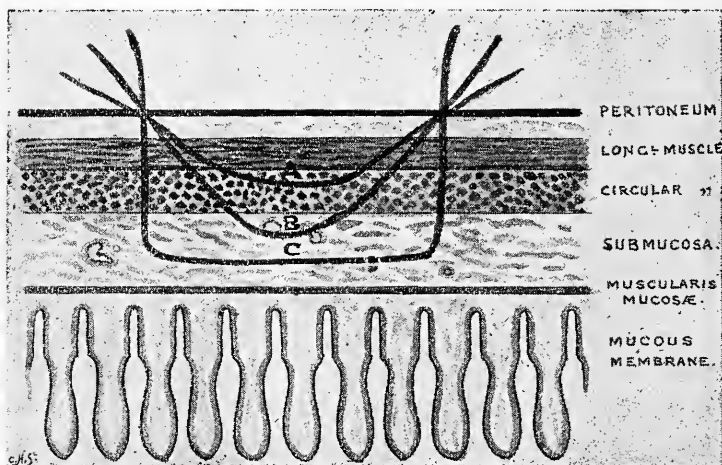
FIG. 129.

Diagram to show Good and Bad Methods of Inserting Suture.

A. Bad method. Suture holds only musculature, and is liable to cut its way out.
B. Not good method ; too little hold of submucosa and too sloping.
C. Proper method.

of the fibrous layer gives greatly increased firmness to the suture grip.   The muscular and peritoneal coats are easily torn through ; the fibrous coat is not easily torn.   The accompanying diagram (Fig. 129) shows the best and the worst methods of inserting the suture.

The above refers to the most common mode of suturing, that

from the peritoneal aspect. Transfixion sutures are used to join divided edges. These, it need scarcely be said, must be infolded, and by a superimposed row of sutures completely shut off from the general cavity. No part of a perforating suture ought to be left in contact with the general peritoneum.

The *methods of suturing* which have been employed are very numerous ; only a few will be described. The varieties may be classified as continuous, interrupted, and mixed — that is, partly continuous and partly interrupted.

The *continuous suture* has its advocates, and much may be said in favour of it. It affords very perfect apposition, it is quickly applied, and it prevents distension of the bowel and so opening of the spaces between the stitches. The continuous suture has been objected to because it remains firm only so long as each stitch remains secure, and that, when it is cast off inside the bowel, a long thread remains to conduct septic material into the holes in which it still lies. The second objection does not hold good if the suture is placed outside in the serous and muscular coats ; and the first is not a strong one if the suture is properly placed.

The best continuous sutures are, in my opinion, those of Dupuytren (Fig. 130) and Appolito (Fig. 131), the latter modified as I suggest. Dupuytren's suture gives perfect apposition of serous surfaces, and is the most easily and quickly inserted of all. The suture of Appolito, modified as shown in the diagram to avoid the necessity of placing a body in the intestine to which the end of
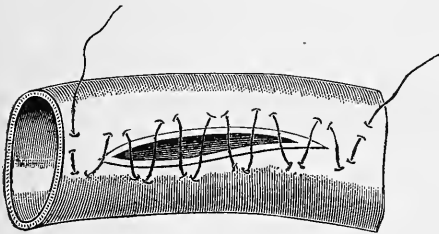
FIG. 130.

Dupuytren's Continuous Intestinal Suture.

the ligature is attached, can also be inserted with great rapidity after a little practice, and gives wonderfully accurate apposition.

There is one objection to the continuous suture, and that is,

that, if the bowel contracts, it is loosened and may permit the
wound to gape.   As a sole means of closing the ends of com-
pletely divided bowel, the continuous suture must be condemned;
but as an extra suture, applied over specially dangerous parts,
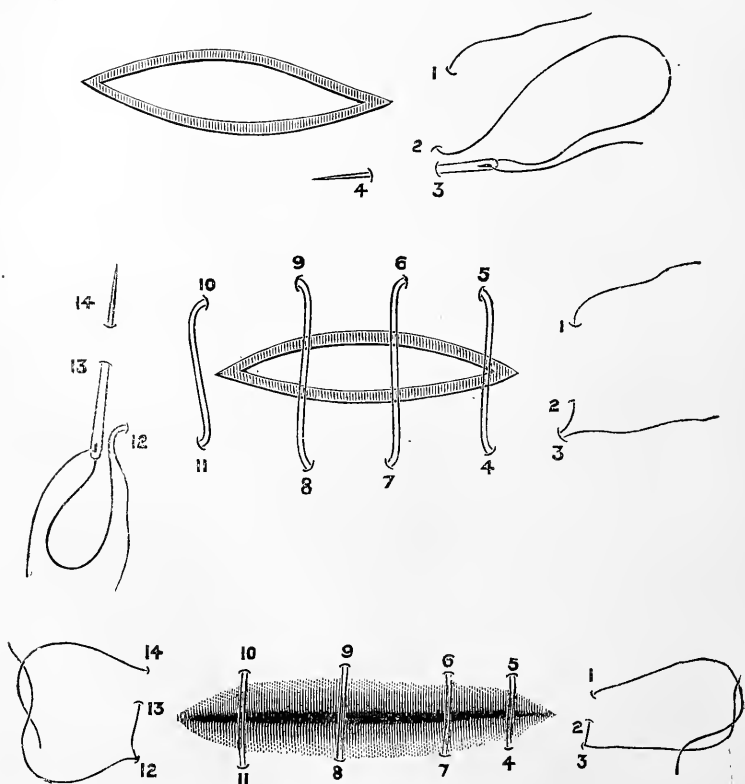
FIG. 131.

The Intestinal Suture of Appolito modified.

to give additional strength and security, it is of great value. Its
chief virtues are, that it can be quickly applied, and that it
prevents distension of the sutured gut and possible gaping
between the interrupted sutures.

Of *interrupted sutures*, the best known are those of Lembert (Figs. 110 and 132), Czerny (Fig. 133), and Gussenbauer (Fig. 134). In Lembert's method, all the sutures are placed outside the bowel: this, always the favourite method, I believe to be still the best. Czerny's method combines Lembert's, with the addition of a second row passing through the whole thickness of the gut and tied inside. Gussenbauer's method combines the Czerny and the Lembert in one suture, but does not, like the former, traverse the mucous membrane. An objection to Gussenbauer's suture is, that the thread inside the bowel may not be perfectly buried,
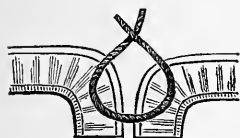
FIG. 132.

Lembert's Intestinal Suture.
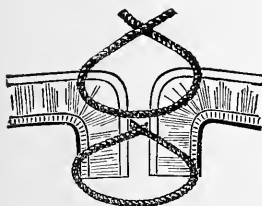
FIG. 133.

Czerny's Intestinal Suture.

FIG. 134.

Gussenbauer's Intestinal Suture.

FIG. 135.

Bishop's Intestinal Suture.

and thus cause a risk of carrying intestinal fluids into the general cavity.

Bishop (Fig. 135) has introduced and successfully employed in the lower animals an ingenious and satisfactory suture. It is a sort of interrupted shoemaker's stitch introduced on the mucous aspect, each suture-loop being tied on alternate sides of the line of junction. It is not a rapid

40 *

method of suturing, nor is it very easy of application; and it is open to the further objection, that the sutures are all on the mucous aspect, and that they, by their series of transverse constrictions, necessarily cause narrowing of the calibre. I believe that, as a subsidiary suture to be applied at weak parts, Bishop's is of great value; but as a complete suture for the whole, I think it might be excelled by others.

Special mention must be made of the "quilt" suture of Halsted.* (Fig. 136.) In his numerous experiments he found it the best of all. It takes a very powerful hold of the tissues, and will bear a great strain without causing tearing: on this ground, I would advise its use in putting the parts on the stretch for the applica-tion of the Lembert suture, even where it is not employed throughout. The "plain-quilt stitches" do not produce such deep apposition as the "buried-knot half stitches." Although it has not yet been proved that they are as good as the Lembert for operations on the human subject, still there can be no doubt that they provide us with a very strong and easily applied method of suturing which may be employed to supplement other methods. Personally I have a high opinion of the value of Halsted's suture, and I employ it very frequently.

FIG. 136.

Halsted's Plain Quilt-Suture.

Invagination methods of suture, such as Jobert's, I do not describe as I consider them inferior to others.

Of *accessory apparatus* employed in enterorraphy we are here, as elsewhere, provided with a variety which is almost endless, and is still being added to. The employment of cylinders to aid in the junction of divided intestine is almost prehistoric. Fabricius ab Aquapendente, who flourished in the latter half of the sixteenth century, speaks of the practice in words of which the following is a translation: "There are some fools

* *Internat. Journ. of Med. Sc.*, Oct., 1887.

who before suturing the intestine, insert a cannula composed
of elder-pith, or a piece of a dried artery of some animal,
or a bit of another intestine, to avoid having the sutures
carried away in the passage of food." According to
Travers,* the "four masters" who practised in Paris towards the
end of the thirteenth century were credited with having used a
calf's trachea for the purpose. This proceeding, like many
another in surgery, after being despised and rejected, has been
resuscitated and is now recognised as one of the best. Neuber
introduced decalcified bone as the cylinder in 1884; and Mayo
Robson, using the same material in his bobbins, has had an
amount of success which has been surpassed by no other method.
Few materials can surpass the trachea of the calf as used by
the four masters; and the humble turnip of the cow-doctor
quoted above has to-day its supporters. Cylinders of tallow,
cacoa butter, dough, isinglass,
potato, and other materials have
been employed, and have been
advocated. But, on the whole,
decalcified bone is the best
material. It is sufficiently dur-
able, it does not warp, it seems to
be well tolerated by the bowel,
and it has a firmness and tensile
strength which enables it to be
cut thin so as to leave a large
opening for the passage of in-

FIG. 137.

*Author's Decalcified Bone Cylinder
for Enterorraphy.*

testinal contents, while strong enough to support the sutured
bowel.

Of the decalcified bone cylinders the best known, and the
first reported as successfully employed, are those invented by
Mayo Robson. Five years ago I had made a set of bone
cylinders which I have occasionally used, and gradually changed
to the shape shown in Fig. 137, which I think gives the maximum
of benefit to be got from such apparatus. It will be seen that a
deep sulcus, with overhanging lips, runs across the cylinder; in

* *Injuries of the Intestines.* Lond., 1812.

this the infolded ends of the intestine are buried and confined by continuous sutures.

Another useful cylinder is that introduced by Robinson of Toledo,* and modified by Jessett † and by the writer (Fig. 138)

With it there is denudation of mucous membrane, and attachment inside the denuded bowel.

A very successful method, although it has not been extensively employed, is that of Paul of Liverpool. (Fig. 139). It involves invagination of the bowel. It is described as follows: ‡ —

"First the operator is prepared with a decalcified bone tube, like that shewn in the diagram A, to which is attached a needle and a strong silk thread, called the traction thread. The tube is required chiefly to enable the operator to produce an invagination of the bowel which will cover the line of union; but it is also useful for keeping open the channel of the intestine, and as a splint to keep the parts quiet during the early stages of repair.

Fig. 138.

Bone-cylinder of Robinson with denudation of Mucous Membrane.

A. As modified by Jessett.
B. As modified by Author.

"The piece of bowel having been excised, the tube is sewn into the upper end, and the traction thread passed through the wall of the lower segment about three inches down, as in

* *Ann. of Surg.*, Feb. 1891.   † *Surg. Dis. of Stomach*, Lond., 1892, p. 270.
‡ *Liverpool Med.-Chir. Journ.*, July 1892.

Figure 139, B. Next, the two cut ends of bowel are quickly attached to each other with a continuous suture. An assistant now draws firmly on the traction thread, whilst the operator produces a short invagination which is retained in position by three or four Lembert sutures. (Fig. 139, C.) Finally, the traction thread is drawn tight and cut off short, its ends dropping into the bowel."

Other good methods by bone cylinders have been introduced by Jessett,* whose plan gives infolding and slight invagination, and by Allingham.†

Other varieties of cylinders have been employed; but as these are not recommended and as it would only complicate the description of the operation, already complicated enough, to give an account of them, they are not referred to.
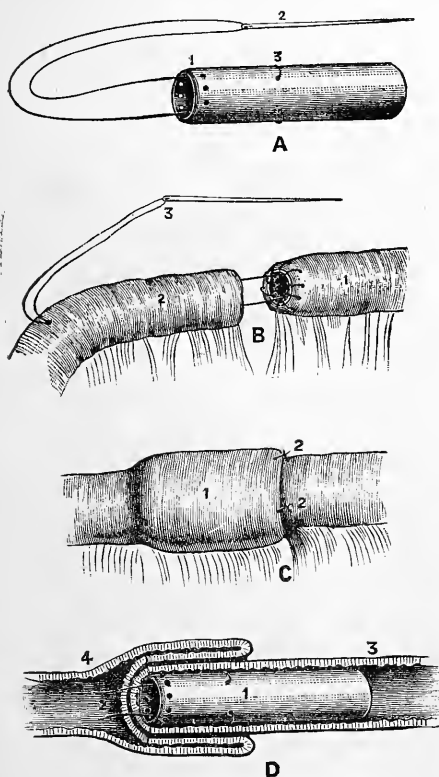
FIG. 139.

Paul's Method of Enterectomy.

A. The decalcified bone tube. 1. The lower or distal end perforated for sewing to the bowel. 2. The traction thread armed with long sewing needle. 3. Its attachment to the tube.

B. A stage in the operation. 1. The proximal end of the bowel with the tube sewn in. 2. The distal end not yet sewn to the proximal end, but with the traction thread, 3, passed.

C. The operation completed. 1. The sheath or intussuscipiens of the invagination. 2. The Lembert sutures for retaining the parts in position.

D. The parts dissected. 1. The tube *in situ.* 2. The traction thread cut short. 3. The proximal end of bowel entering the intussusception. 4. The distal end supplying the returning and ensheathing layers.

* *Loc. cit.*, p. 265. † *Lancet*, Aug. 31st, 1895.

The *Anastomosis Button* of Dr. Murphy of Chicago (Fig. 140) represent the latest and most ingenious accessory in enterorraphy. In very small compass, and with marvellously complete mechanical arrangements, it is at the same time a cylinder and a suture. With it no sutures are necessary, save a purse-string stitch to gather the bowel closely around the stems. There is no invagination of bowel, only infolding. With its aid the operation of intestinal junction can be effected with great rapidity and ease. The gripped margins of bowel undergo pressure atrophy or they slough, and the button is passed per anum. There is provision for the passage of the intestinal contents, and no risk in keeping the bowels acting while the button is in position.
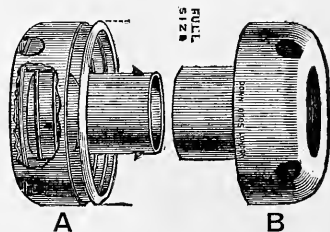
FIG. 140.

Murphy's Button.

A shows male half of Button, which has a spring flange for keeping up pressure as atrophy proceeds. The two springs projecting through the fenestra in the hollow stem act as the male thread of a screw when the shank is telescoped within the stem of B.

B shows the female half of the Button.

Buttons of various sizes and shapes are employed in different operations. A large size is used for the large intestine, and a small size for the operation of joining the gall-bladder to the bowel—Cholecyst-enterostomy. For lateral approximation, a flat long button is made with a handle to undo the catch instead of a screw. (Fig. 141.) Murphy himself, wisely I think, prefers the round button and end-to-side approximation, to side-to-side; and end-to-end junction he considers best of all.

Of other apparatus the decalcified bone plates for lateral approximation, already described (p. 543), may be mentioned. Jessett has introduced bone plates with a hollow cylinder which is fixed to one plate and passes through the other.

We may now proceed to describe in detail a few of the best methods. Those selected are:—
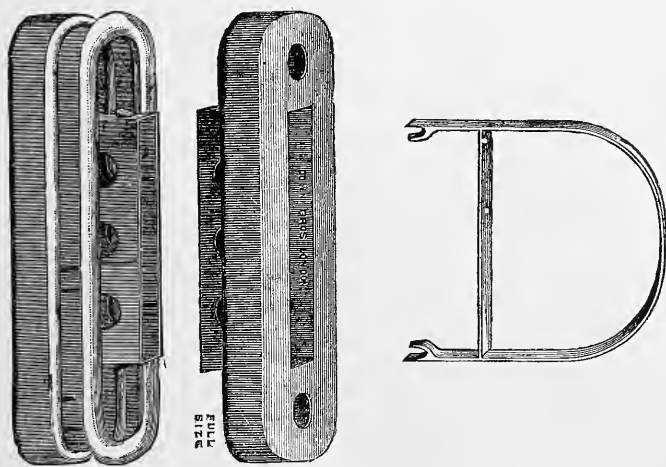
FIG. 141.

Murphy's Oval Anastomosis Button with Disengaging Key.

END-TO-END ENTERORRAPHY BY SUTURE.

This method may be understood by reference to the accompanying drawing, made to scale (Fig. 142). The drawing, being made for a previous edition, does not show what I believe to be the most perfect details. Makins' clamps are shown instead of Lane's, and a continuous perforating inside suture is not shown. It shows how the most important steps are carried out, and will perhaps serve the purpose. In the first instance

I prefer to make the description follow the drawing : the suggested improvements will be described at the end.

The diseased intestine has been cut away, the mesentery being divided as close to the bowel as is deemed desirable, and
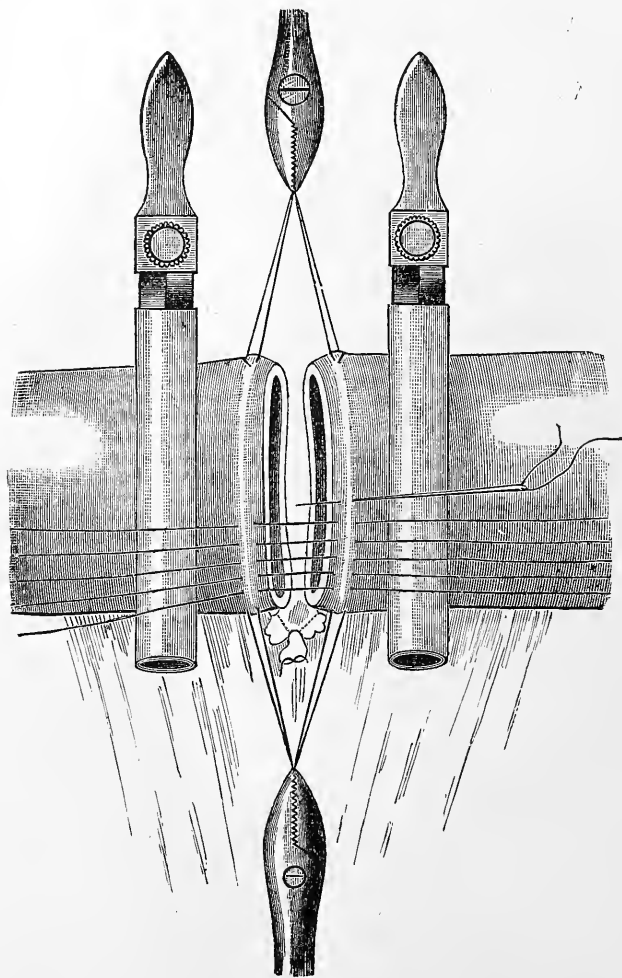
FIG. 142.

Drawing to show method of Intestinal Suture.

(For description see Text.)

no wedge-shaped portion being removed. Two Makins' clamps, covered with rubber-tubing, have been applied, at a distance of about half an inch from the divided ends of bowel. A purse-string stitch has been so arranged along the divided margin of mesentery that it draws together the gap of cellular tissue and the attached margins of gut, while it leaves free small flaps of peritoneal membrane which may, if deemed desirable, be grafted on to the base of the line of union. Four quilt-sutures have been inserted on the opposite sides of the divided gut, in the exact lines in which the Lembert sutures are to be placed; the two on each side are gathered together in the blades of catch-forceps, and gentle and steady traction made on them by an assistant. This raises a well-defined fold along the edge of the bowel; into this fold the sutures are inserted. The insertion of these quilt-stitches makes certain that equal distances of the bowel are arranged for suturing, and also by raising a fold makes the insertion of stitches more easy, and ensures their being placed in a straight line. The whole operation is carried out while the parts are resting on a warm sponge-cloth lying on the abdominal wall, and while several sponges packed into the cavity keep back the bowels. The assistant, with one hand, holds one pair of forceps, and steadies the clamps by their extremities; with the other he holds the other pair of forceps.

About a dozen ordinary milliner's needles are threaded with the fine silk selected for the purpose. Each needle carries sufficient silk to make three sutures—say, eighteen inches in length altogether. Three stitches may be placed as a continuous suture with one thread eighteen inches long; the loops are divided, and another threaded needle is taken up. If the needle is not too sharp, the insertion of the sutures may be carried out with great practical facility and almost physiological precision. Halsted's statements as to the resisting nature of the strong fibrous coat are verified at every stitch : it is scarcely possible to ignore them. The needle passes readily through the serous and muscular coats, then it is checked; a rapid change from the vertical to the horizontal position picks up a few threads of the tough fibrous coat, it is pushed along a little way then tilted

again, and the needle emerges, to be inserted in the same way on the other side.

Thus the sutures are placed along one side of the bowel between the quilt-sutures. They are then gathered together in the hand of the assistant, as in closure of the parietal wound in abdominal section, and systematically tied from one end to the other. Finally the quilt-sutures are tied, the four threads being either tied in one knot or in two. The same process is now carried out on the other side, and the operation, so far as the bowel is concerned, is completed. The gathered-up layers of mesentery are finally inspected; and if there is any redundant tissue, this is raised as far as possible up the line of union on the intestine and fixed there by a suitable stitch. This will add to the strength and security at a point where experience has shown it to be specially wanted.

Senn's mode of using grafting or transplantation of the omentum is clearly a most valuable suggestion, and one which, as grafting especially, I should certainly employ, where possible, in every case of resection. Indeed, wherever a wound of a hollow viscus has to be closed, it will add to the security if we fix the omentum by a few stitches over the sutured wound. I have done this for the wound in the stomach made for dilatation of the pylorus.

The clamps being removed, the intestinal contents above them are permitted and encouraged to pass downwards, and the security of the suture carefully tested. At any point which seems weak, a continuous Dupuytren's suture may be inserted. A continuous suture placed all round as an over-stitch will always add to the safety.

The improvements which I would suggest in the above method are the following:

(1) The use of Lane's clamps or the modifications suggested by the writer. These take up less room than Makins', and they cannot possibly slip.

(2) The insertion as a first step of a continuous perforating over-stitch which underlies the Lembert suture. This is done, firstly, by laying the two intestinal tubes side by side, and joining

the apposed walls by a continuous suture which perforates all the coats and goes a little beyond the angles; secondly, by straightening the bowel and placing a similar suture in the anterior half without apposition of the intestinal walls. The second suture is not pulled tight till it has been placed, and it goes beyond the first at each end for a little way. Then the four ends of the two sutures are pulled tight and tied. There is no real difficulty in placing this suture; delicacy and judgment are, however, required to get a perfect result.

(3) The Lembert suture is placed over all, as in the drawing.

The bowel now sutured is thoroughly cleansed by a stream of warmed boro-glyceride solution, and is treated in one or other of three ways:

(1) It may be returned into the abdominal cavity, the abdominal wound being closed over it in the ordinary way.

(2) The bowel, carefully protected, may be left outside for a few hours till adhesive inflammation has sealed up the lines of incision. The sutures in the parietes are placed in position, but not tied till the bowel has been returned. Schede suggested this plan; but the risks of distension of the extruded bowel, and of extrusion of more bowel, are so great, that it has not generally been adopted. More recently Briggs of St. Louis * has introduced a method of extra-abdominal intestinal suture in which, besides covering the line of union in the bowel by a thin animal membrane, he uses a ring or frame which carries four needles, on which the protruding intestine is supported. The risk of gangrene at the line of junction, always considerable in cases of resection, must also be increased by the flexion and compression induced by leaving the intestine protruding from the parietal wound. If it seems necessary rapidly to finish an operation, and the process of suturing is not perfectly satisfactory, then the gut might be fixed outside for a few hours by passing a thick pin through the mesentery and letting its ends rest on the parietes, while cohesion to the edges of the incision might be prevented by the interpolation of pieces of protective or gutta-percha tissue.

* *St. Louis Med. and Surg. Journ.*, July, 1890.

(3) The sutured bowel is returned, and fixed by a stitch or two to the parietal peritoneum. The abdominal wound is left open at the point of fixation, but closed above and below. A good many cases which have recovered have done so after fæces had burrowed an opening through the closed parietal wound ; and some have died, apparently because free exit was not given to extravasated intestinal contents. There is no strong objection to this plan ; if there is any doubt as to the perfection of the suturing, it ought to be followed. When, however, there is no good reason to the contrary, the best plan in nearly every case is to return the sutured bowel into the cavity and close the parietal wound over it.

A method of placing the first continuous perforating suture which I think highly of is that of Connell ;* but as I have seen no reports of its success in the human subject, I do not describe it.

ENTERORRAPHY BY MAUNSELL'S METHOD.

The essential principle of this method is, the production of a temporary intussusception of the divided ends of the bowel through an incision in the bowel and suturing the free ends while thus pulled through the incision (Fig. 143). The steps may be followed by reference to the accompanying diagrams.

The clamped bowel being resected and all bleeding stopped, and the mesentery, if a **V**-shaped piece has been removed, being sutured, two temporary sutures, transfixing all the coats of both ends of the bowel, are placed at the mesenteric and the free borders and tied, while the ends are left long. In the free border of the larger bowel, two inches from its divided end, a longitudinal incision an inch and an half in length is made by pinching up the intestinal walls between the finger and thumb and transfixing with a fine scalpel. Through this opening the free ends of the temporary sutures are pulled (A, Fig. 143). Then by dragging on these sutures the two ends of the divided bowel are invaginated and drawn through the incision, where they appear as a double tube, one inside the other, peritoneum lying on peritoneum in the

* *N. Y. Med. Rec.*, 1892, vol. xlii., p. 235.

middle, and the mucous coats being inside and outside. While held in this position the sutures are placed by complete transfixion of the two sides by a long needle (B, Fig. 143). As suture material Maunsell used fine horsehair. Each transfixion places two sutures, one on each side; the suture is divided in the middle, and each half at once tied and its ends cut short. In this way suturing is carried all round, about twenty sutures being placed by ten transfixions. The temporary sutures are now cut off short and the invagination is reduced. The longitudinal opening is closed then by interrupted Lembert sutures (C, Fig. 143).

For cases where one segment of bowel is much larger than the other he modified the operation a little, so that two temporary upper sutures are made to draw the superfluous piece of bowel through the incision and permit of its being sutured from the inside as well as the general intestinal walls.

Nothing is said of the insertion of a superimposed suture, although this single row of sutures is perforating. Such
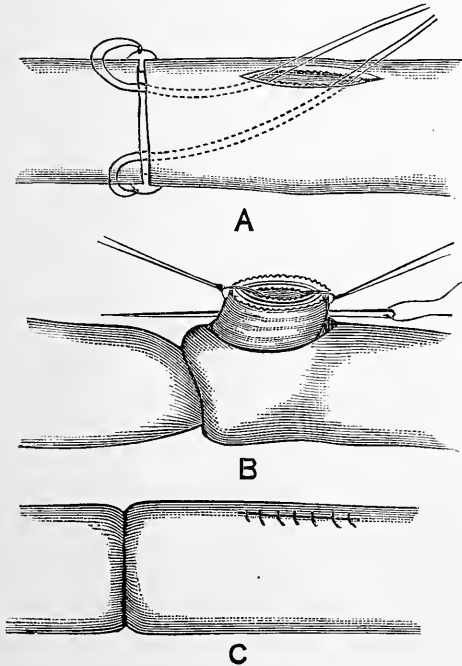
FIG. 143.

Enterorraphy by Maunsell's Method—mesenteric border below, free border above.

A. Temporary sutures placed and ends carried through incision in upper bowel.

B. Divided ends pulled through incision and needle transfixing for first stitch.

C. Operation completed.

a row of sutures would, in the opinion of most, add to the safety.

The sutured bowel is cleansed in the ordinary way and returned free into the cavity.

END-TO-END INTESTINAL JUNCTION BY MURPHY'S BUTTON.

Resection having been carried out in the ordinary way, after ligature of the mesentery, steps are at once taken for the insertion of the two halves of the button.

A puckering or purse-string stitch (Fig. 144) is first carried round the divided end of the bowel, beginning at the point furthest distant from the mesentery (Fig. 144, *b*). At the mesenteric junction one return over-stitch (Fig. 144, *a*) is made to make certain that both layers of the peri-toneum overlap.

The return over-stitch is of great importance and should be most accurately placed. The buttons, held in forceps (Fig. 145), are introduced into the bowel ; and the puckering sutures are tied closely around the stems (Fig. 146).

The two halves of the button are now joined by simply pushing the male half into the female, and the operation is completed. No reinforcing sutures are required. If the bowel is properly gathered in around the stems, the flanges pressed together by the spring inside will keep up accurate apposition of the serous surfaces of the bowel.

For end-to-end junction, buttons of two sizes are used—the smaller ($1\frac{5}{16}$ in.

FIG. 144.   (MURPHY.)

Insertion of Puckering Stitch for Murphy Buttons.

a. Return Over-stitch.
b. Ends of Suture.

in diameter) for the small intestine which has to pass through the ileo-cæcal valve, and the larger ($1\frac{1}{4}$ in. in diameter) for the large intestine. In making the junction care should be taken that there is perfect involution of the mucous surfaces and that only serous surfaces are apposed. Murphy particularly
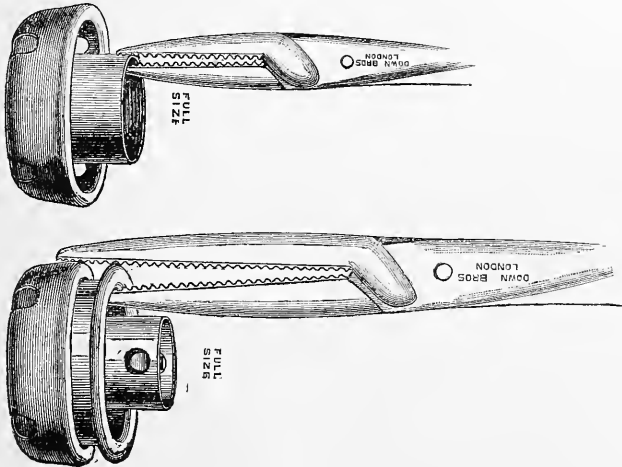
FIG. 145.

Murphy Buttons held by Forceps preparatory to introduction.

insists on the importance of the returning over-stitch at the mesenteric border; it is easy to understand how any imperfection here may lead to disaster. It is scarcely necessary to add that no torsion of the ends should be made in pushing the halves of the button home.
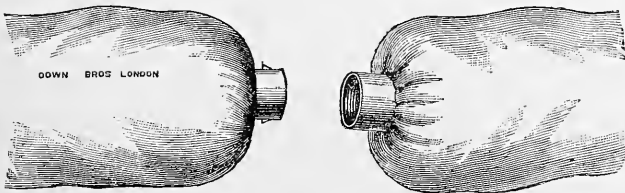
FIG. 146.

Halves of Button inserted and ready to be pressed together.

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END-TO-END ENTERORRAPHY BY DECALCIFIED BONE CYLINDER.

In this method purse-string sutures are carried round the divided ends of the bowel exactly as for the Murphy button. (Fig. 147.) The sutures are inserted, beginning at the free border and ending there, and the same care is taken to carry out Murphy's suggestion as to the placing of a mesenteric over-stitch. Each stitch passes through all the coats at about a quarter of an inch from the free margin, the free ends coming out close to each other.
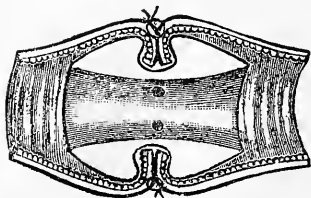
Fig. 147.

Enterorraphy with decalcified bone tube.

When the sutures are inserted the cylinder is pushed into one end of the bowel, and by gradually tightening the suture the incised end is buried in the groove and fixed there by tying the free ends of the suture. The other half of the cylinder is pushed into the other end of the bowel, and by tightening and tying the suture the divided end of the bowel is buried in the groove while the peritoneal coats are in apposition, and if the cylinder fits well the intestinal walls are a little compressed. The incised ends of the bowel should be invisible and the knots of the sutures should be completely buried. To permit of the escape of secreted mucus into the cavity of the gut, there are several perforations in the cylinder at the bottom of the groove.

To add to the security, a continuous Dupuytren or Appolito suture is carried around the whole circumference of the bowel; and this may be specially reinforced at the mesenteric junction and at the free border where the knots are buried.

END-TO-SIDE ENTERORRAPHY BY SUTURE.

By this is meant the implantation of the divided end of the upper bowel into the side of the lower bowel through an incision

made for its reception and suture.   (Fig. 148.)   This method will usually fall to be performed in the junction of ileum with colon. It is most suitable where the receiving bowel is larger than the entering, and this can rarely be of the proximal into the distal where there is stricture, because then the proximal bowel is the dilated portion.   The proximal bowel might be made to receive the distal, but this would leave opposed to the current a pouch which might harbour fæces.

The mode of operating is shown in the accompanying Figure (148), modified from that suggested by Jessett. The divided extremity of the receiving bowel is closed by a double row of sutures. The first suture is a continuous puckering Dupuytren's suture, which draws the opening together and causes infolding of the ends with approximation of the serous surfaces. The outer row is either a Dupuytren or Lembert suture.

An incision is then made on the side of the bowel most conveniently placed for receiving the open end of the upper bowel, and of a size just large enough to receive it. Two holding sutures are inserted, as shown in the upper Figure, into the sides of the entering bowel, and at the ends of the incision in the receiving bowel. These hold the bowel in the incision, through which it enters a little way. A complete series of Lembert sutures is then inserted all round the junction, as shown in the lower Figure (148), and the operation is completed. The entering bowel should go well inside the incision and the outer sutures

FIG. 148.

Enterorraphy by Lateral Implantation.

41 *

should go well beyond the line of junction, so as to cause considerable infolding.

In this operation it would be easy to employ Maunsell's method of uniting the bowels. Before the end of the receiving bowel is closed the lines of junction could easily be pulled through it by means of temporary sutures, and the junction could then be made by transfixion sutures. Then, after pulling back the sutured portion, the free end of the receiving bowel could be closed.

By the aid of apparatus, cylinders of bone or the Murphy button, this method of junction could be carried out as easily as the end-to-end method. With each apparatus the steps in the operation are the same for the entering bowel as in end-to-end junction, and for the receiving bowel the same as in gastro-enterostomy by apparatus already described.

ENTERORRAPHY BY LATERAL APPROXIMATION.

In this method both open ends of the bowel are closed and the continuity of the tube is established through approximated lateral openings, which are united either by simple suturing or by the aid of special apparatus.

The steps of the operation by simple suture are shown in the accompanying Figures (149). The free ends of the divided bowels are first closed by a continuous puckering Dupuytren suture, reinforced by a set of Lembert over-stitches which causes complete unfolding of the first set of sutures.

Then the sides of the bowels are approximated in suitable and convenient positions, so that they lie unstrained side by side. Two incisions of equal length, from two to three inches according to circumstances, are then made through all the coats of the bowels midway between the mesenteric and the free borders where the apposition is to be made. Then two fixation Halsted sutures are inserted into the apposed walls of the bowels, so as to keep the ends of the incisions exactly opposite each other. A continuous suture is then passed through the lower lips of the apposed openings in the way

shown in the top Figure (149). This perforates all the coats and brings the serous coats into accurate apposition. The same sort of suture is then inserted into the anterior half of the incision in the way shown in the middle Figure, and produces sero-serous junction. These sutures ensure the existence of a large patulous opening between the divided ends. A reinforcing set of Lembert sutures is placed over the continuous sutures, and the operation is completed as shown in the lowest Figure.

FIG. 149.

Enterorraphy by Lateral Approximation and Suture.

Intestinal junction by lateral approximation may be very rapidly and satisfactorily performed with the aid of Senn's *decalcified bone plates.* The open ends of the intestines are closed, as if for approximation by simple suture. The plates are inserted in the manner shown above (Fig. 116). Two incisions are made on corresponding apposed aspects of the bowel long enough to admit the plates in their smallest diameters. The plates are already threaded with silk or chromicised catgut, and the middle sutures are passed through

FIG. 150.

Senn's Decalcified Bone Plate.

needles. These middle sutures are passed through all the coats of the bowel a little way from the edges of the incision ; the end sutures do not traverse bowel, but lie at the ends of the intestinal wound. After gently scarifying the intestinal surfaces to accelerate union, the ligatures in the plates are tied and the knots buried between the approximated intestinal walls. A reinforcing continuous Dupuytren suture inserted over the edges of the plates completes the operation. To add to the security, an omental graft may be placed in the retiring angles between the bowels and fixed there with a catgut suture ; this, however, is not necessary.

The operation may be done with the help of Murphy's special lateral anastomosis instrument (Fig. 141) or by his round button, or by the use of special flanged cylinders or bobbins. Special descriptions of the employment of such apparatus are not called for.

Selection of Method.—There is no one best method in this operation. The selection should be varied according to many conditions, which differ in each case. To lay these down in specific terms is impossible ; but it may be possible to formulate certain guiding principles from which useful practical deductions may be made.

These principles may be discussed separately from the point of view of the operation and of the patient. The most useful discussion will be from the combined aspect. It is unfortunate that the interests of the patient and the operation often clash : an attempt will be made to combine a maximum of good for each.

As to the operative methods, I may say at once that I believe the best from the purely operative point of view is that by simple end-to-end suturing. But this demands conditions which are seldom present. Such are, a fairly healthy condition of the bowel above and below the disease, without either dilatation or contraction, and a condition on the patient's part which permits of the giving of abundant time to the completion of the operation. Experience and dexterity on the surgeon's part must be added.

As to the actual method of suturing adopted, I think there is

not much choice. The method shown in Fig. 142 may be improved upon by the primary insertion of a continuous or a Bishop's suture at the mesenteric junction and as far round the bowel as it can easily be placed. Over all a Lembert or Halsted suture properly inserted would provide union quite satisfactory for all purposes.

Maunsell's method (Fig. 143) has been a good deal employed, and is spoken well of. It gets good primary apposition, but at the expense of making another incision in the bowel. The same sort of suture as Maunsell's can be inserted by Bishop's plan without making this second incision, and quite as speedily. Maunsell's method is perhaps easier ; but the necessity for making and closing the second incision in the bowel, without any real superiority in the method of suture, renders it inferior, in my opinion, to the first method.

The first rule which I would venture to formulate is as follows : Where the patient is in good condition, and the bowel is healthy and of equal calibre above and below, use simple suturing, inserted as a continuous sero-serous over-edging or a Bishop's suture inside, and as an interrupted Lembert or Halsted suture outside.

The next selection will involve the use of apparatus ; and of these I would pick out the decalcified bone-bobbin or cylinder and the Murphy button. The Murphy button is in some ways almost a perfect piece of mechanism, and it is possible that the objections which I have to it may prove to be unfounded. Thus, I fear the possibility of gangrene. No hospital surgeon accustomed to interpret the effects of gangrene in the bowel, even if of limited extent, can regard with equanimity the deliberate production of two gangrenous rings around the divided ends. It may go no further than "pressure atrophy;" but it may, and has, gone on to gangrene. In the few cases in which I have seen it employed there has been pain, great intestinal worry, some shock and sickness. This shock, at the end of three days, in one case came on suddenly and almost killed the patient. In another case (an old man of seventy) shock on the third day did cause death, and two gangrenous rings of bowel inside the button

flanges was all that was found to account for death. I repeat that I speak with much diffidence; but my personal experience of the manner in which the cases recover after the use of the Murphy button has led me to prefer the use of the bone-bobbin or cylinder.

In respect of rapidity of application the button is speedier than the bobbin, but in skilled hands certainly not by more than five minutes. The constricting over-stitches are the same for each; the continuous Dupuytren suture over the bobbin demands the extra time. On the other hand, there is none of the shock which follows crushing of the intestinal wall ; there is little or no intestinal worry ; and after the first day or two there is no further risk to be apprehended.

I have said nothing of the chance of the metal button becoming a cause of intestinal obstruction, because this danger is evidently not great. Such a risk can scarcely attach to the bone-bobbin. Many other arguments for and against both methods have been adduced ; those only are given which, in the writer's opinion, seem to have most weight.

Now, it is the case that most patients submitted to enterectomy are not in a condition to bear a prolonged operation ; therefore it must happen in most cases that where the operation is to be completed at one sitting the use of time-saving apparatus will be called for. Also, the bowel is likely to be dilated or inflamed above the disease and contracted below ; here the value of apparatus is again conspicuous.

The second rule would then be : Where the patient's condition is only fair, and the bowel is not quite healthy and of unequal calibre above and below the lines of resection, junction is best made by end-to-end union by the aid of a grooved bone-cylinder, or by a Murphy button, preference being given to the simple cylinder, especially in fragile or aged patients likely to be affected by shock.

As to the other methods of end-to-side and side-to-side junction, mediate or immediate, another set of conditions call for consideration. It has already been said that there is nothing to prove that lateral approximation is more successful in its imme-

diate or remote results than end-to-end junction; and the same may be said of end-to-side junction. Herein the surgeon has a free hand. He would have to vary his method as follows:—In a case of enormous distension of bowel above and great contraction of the bowel below the lines of resection, where any apparatus would be inefficient, end-to-side or side-to-side junction would be advisable. If the distal bowel is very small, we must remember the risk of leaving too small an opening in the proximal gut to receive it; lateral approximation does away with the risk of future stricture. End-to-side junction is the natural method of joining the small to the large bowel, and with resection of the cæcum this method of enterorraphy will most often fall to be done.

In these methods of operating it must not be forgotten that a good deal of time must be given to the closure of the free ends of bowel, and that this is time superadded to the methods of end-to-end junction.

As to the methods to be employed; here, as in end-to-end junction, I would give preference to the employment of the simple suture. For end-to-side, Jessett's method (Fig. 148) is I think the best; for side-to-side junction, Abbé's (Fig. 149) is as good as any. If apparatus is to be used, I think the choice is about equally balanced between bone-bobbin, Murphy's button, and Senn's plates. On the whole, I would give preference to Senn's plates.

A third rule would be :—If the patient's condition is fair, and the bowel is moderately healthy but of very unequal calibre, the proximal bowel being greatly dilated and the distal bowel much contracted, lateral approximation by direct suturing after closure of the divided ends is to be employed. If the patient's condition demands the use of time-saving apparatus, Senn's plates may be selected. End-to-side junction is most likely to be satisfactory in joining ileum to ascending colon after resection of the cæcum.

There is one more condition which we have to deal with, and this perhaps the most important of all—that is, *where there is intestinal obstruction.*

It is only too well known that patients suffering from intestinal obstruction are peculiarly intolerant of operation. The reasons of this do not now concern us; the fact will scarcely be disputed. I have thought that in cases of obstruction where the cause is situated in the large bowel, and where there is a large accumulation of fæces in the small as well as in the large intestine, this operative intolerance is most marked. The toxæmia would seem to cause more depression than the other effects of obstruction. Although the patient may not seem so ill in these cases as in those where there is true strangulation, he bears operation worse—if a " worse " can be affirmed of either.

I have come to the conclusion that to resect living intestine during obstruction is surgically unsound. And I doubt if any improvement in methods will ever make the operation justifiable. The shock and the illness which follow resection of bowel, however small, are too great to put on a patient suffering from intestinal obstruction. The shock has seemed to me to be greater in stricture even than in gangrene. In gangrene the resection is already done, so to speak; the disease will have been more acute, and stercoral toxæmia either absent or not so pronounced.

I believe that in all such cases we ought, firstly, by the smallest possible operation, to relieve the obstruction, and thereafter to resect the bowel. The method I advocate combines fixation of the cancerous growth outside the abdomen with drainage of the intestine above the stricture; and the further proceedings of resection of intestine and closure of the artificial anus are done outside the peritoneum. The details of the method may be conveniently described here.

ENTERECTOMY IN THREE STAGES.

The operation involves three steps or stages: firstly, fixation of the cancerous growth outside the abdominal incision, and immediate establishment of intestinal drainage; secondly, resection of the cancerous growth; thirdly, closure of the artificial anus.

The first part of the operation is done through an incision made, if possible, over the seat of stricture. By the help of auscultation, by watching the contractions of the bowels for a few moments, and with the guidance of the patient as to the seat of pain, the actual position of the stricture may sometimes be diagnosed satisfactorily. But frequently this is impossible, and then the incision is made in the middle line a little above the umbilicus. The incision should be about two and a-half inches in length. The diseased gut is pulled out through the incision, if possible; if not, another incision is made over the disease where it can be drawn outside without much traction. By judicious employment of traction on the mesentery, not on the bowel, the bowel may be more easily brought to the surface. Then a stiff rod (a chemist's vulcanite stirring rod is what I now use) is pushed through the mesentery under the disease, and laid on the parietes. No sutures are necessary. If the disease is extensive, or if the bowel above is much hypertrophied, two rods may be inserted some distance apart, so as to keep outside a considerable length of bowel, and prevent retraction inside the abdomen by tilting the growth over the rod. This part of the proceeding can scarcely occupy more than five minutes; the further steps require no anæsthesia.

The next step is to place an intestinal drainage tube in the bowel above the stricture. The whole of the extruded bowel is covered with sponge-cloths wrung out of hot lotion. An incision is made in the bowel above the stricture or growth, large enough to take a piece of stout rubber tubing as thick as the forefinger. It is inserted on the stretch and, when it resiles, accurately fits the opening in the bowel. The tubing need not be larger than the forefinger, as the fæces are nearly always liquid; and the tube being compressible, any blocking can be overcome by pinching. The tube should be about two feet in length, so that the end may rest in a receptacle by the side of the patient. It is fixed to the bowel by a safety-pin passing through the walls of the tube and the intestine. If there is any sign of leakage, a purse-string overlapping but not encircling suture (this may cause sloughing) may be made to give accurate apposition.

The dressings are now applied. A layer of gutta-percha tissue is first laid over the intestine to prevent adhesion to the dressings. Then strips of boric lint are laid round the bowel so as to form a pyramid, pressing the intestine close up to the tube and preventing any chance of further extrusion. A broad piece of strapping is passed round the back of the patient, its ends split and made to interdigitate over the dressing, and overlapping about a foot. At the point where the four ends cross, the tube passes out. A little extra lint is placed round the tube at its exit; this is looked at frequently to see that there is no leakage, and changed if necessary. In this method of doing colostomy there is practically never any leakage; and I now always do the operation (not necessarily for removable cancer) at one sitting, so perfect is my confidence in ability to prevent contamination of the peritoneum.

At the end of a week or ten days, when the abdomen is flat and the patient has got over all the symptoms of toxæmia and is taking his food well, the protruding and cancerous bowel may be resected. No anæsthetic is necessary. The protruding gut is cut off with scissors quite flush with the parietes. If peritoneum is not brought to the surface, the gut will be found firmly fixed to the parietal incision; there is no fear of the bowel being dragged inside. Catch-forceps are placed on bleeding points and left attached for a few moments. The case is now left to itself for a month or six weeks, till all inflammatory induration has gone and the condition is one of ordinary artificial anus. This is cured by the operation to be described under that head.

My experience of this method of operating has been, though small, entirely favourable. I have had four operations all successful. I was impressed not so much with the recoveries as with the manner of the recovery. After the first few hours, when intestinal drainage was established, no case ever gave rise to a moment's anxiety. In two of the cases the condition of the patient was nothing less than desperate, with complete obstruction, and little more was hoped for than a remote chance of saving life by intestinal drainage. In one case of gangrene, there was a huge sub-peritoneal abscess complicating an otherwise almost hopeless condition. In one, the abdomen was so

distended that I could not get the bowel up to a median incision, but had to make a second incision in the left loin. The parts resected in these cases were transverse colon, sigmoid flexure, descending colon and lower ileum.

My first operation, performed in 1891, was done on the spur of the moment ; a wooden penholder which happened to be in the room being used as a skewer to keep the tumour outside during intestinal drainage. A more extended and not so successful experience of enterectomy by other methods, and not during complete obstruction, has raised in my mind doubts whether enterectomy should not always be done in stages. If we can get patients well after resection of bowel while they are seriously ill from obstruction, surely *a fortiori* we ought to have a very low mortality in cases where there is no obstruction. My firm impression is that the lowest mortality in enterectomy generally would be got from operation in three stages. There is almost no risk to life at any time if there is no obstruction. Then there need be no intestinal drainage. The gut, implanted on the raw parietes, would be firmly fixed at the end of the third day, and then the tumour could be resected. At the end of a few weeks the anus is closed by a simple extra-peritoneal operation. The chief objection is the artificial anus. But few patients will object to this if they know it is but temporary and that it increases their chance of recovery. To the surgeon the additional trouble should count not at all ; and the prolongation of the treatment by a few weeks would have little weight with either a sensible patient or a sound surgeon.

There need be no dispute that the most perfect surgery is complete enterectomy and enterorraphy at one sitting. But if, with all our experience and experiments and apparatus, we get after the complete operation no lower mortality in the next year or two than we do now, I for one shall feel constrained to have resort to the operation in stages. For, after all, the safest surgery is the best.

After-treatment.—The first danger to be met is shock, which in a long operation may be grave. The best treatment is

by alcohol administered by the rectum, for the stomach will probably absorb nothing. In every case, except in those where the resection has been low down in the sigmoid flexure, it will be wise to continue rectal injections containing an ounce of brandy and soluble peptones every four hours for the first day, or longer. Hypodermic injections of strychnia are said to be of value in preventing intestinal paresis. Another reason for rectal feeding is, that the intestines not being stimulated to contract by food entering the stomach, the sutured wound is permitted to rest. The first foods should be such as are absorbed by the stomach, and foods demanding intestinal digestion before being absorbed should be delayed as long as possible. Morphia is best avoided ; but the objections to its use are not so strong as in some other abdominal conditions. Occasional doses of a mild saline such as phosphate of soda, or small doses of sulphate of magnesia, may be administered on the third day. They keep the intestinal contents liquid and prevent stasis.

Where the Murphy button is used intestinal rest is not essential ; and this is one conspicuous advantage in its use. Indeed, purgation is not only safe but desirable, for it does away with all risk of obstruction. And also, with the button, any sort of suitable feeding by the mouth may be begun as soon as the stomach will bear it. Daily liquid evacuations should be kept up till the button passes by the rectum. This may take place at any time during the third, fourth or fifth weeks, or may be delayed even longer. Sometimes the button is found resting in the rectum.

Further measures are adopted in the progress of the case on the lines laid down for the management of abdominal operations generally (p. 134), and need not be here repeated.

The Formation of Intestinal Anastomosis. Entero-Enterostomy ; Ileo-Ileostomy ; Ileo-Colostomy ; Colo-Colostomy.

History.
Indications.
Operative Methods.
 By Direct Suturing.
 By Senn's Plates.
 By Murphy's Button.

As an outcome or extension of Wölfler's operation of Gastro-enterostomy, a similar operation has come into use for the establishment of anastomosis between different parts of the intestines. The principle of the operation is, to exclude from the intestinal tract a piece of bowel which has become incapable of passing its contents along, and has caused, or is tending to cause, obstruction. A short circuit is made between healthy intestine above and healthy intestine below, the portion between being left either because it cannot be removed or because it is not advisable or not necessary to remove it.

History.—The operation has been performed for a variety of conditions. In 1888, Billroth and v. Hacker [*] performed the operation for cancer. Lange [†] in the same year joined the ileum to the sigmoid curvature for irreducible invagination in an infant. Meyer of New York,[‡] also in 1888, had a most successful case of anastomosis between the ascending and the transverse colon for cancer at the hepatic flexure. In the following year Abbe of New York [§] recorded a most successful case of operation for complete obstruction caused by stricture, in which he performed colo-colostomy by using Senn's decalcified bone plates. Since then a good many operations have been performed for different conditions in a variety of ways.

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[*] *Wien. Klin. Woch.*, No. 17, 1888.   [†] *N. Y. Med. Rec.*, Nov. 24, 1888.
[‡] *Ibid.*, Nov. 24, 1888.   [§] *N. Y. Med. Journ.*, 1889.

Indications.—The operation may be performed for unremovable cancer, for stricture, for agglutination by peritonitic adhesions, for artificial anus, and, in a general way, for other conditions, as an efficient measure of less gravity than resection. It has been done for intussusception, and it might with propriety be done for volvulus of the sigmoid flexure.

Operative Methods.—It has been done by simple suture and by means of the various devices described above for enterorrhaphy. Senn's plates have been most generally employed; but Murphy's button, decalcified bone cylinders with or without flanges (Robson; Jessett), cat-gut rings (Abbé), raw-hide plates (Robinson), and other accessories have been used.

The steps of the operation being very similar to those already described for enterorrhaphy by approximation (p. 628), need not be dwelt upon. The bowel above the obstruction will probably be dilated; below, it will be normal or contracted. The seat of anastomosis, while as close as possible to the seat of disease, so as to remove as little intestine as possible from the process of digestion, should not be so close as to make tension necessary, nor to necessitate junction of greatly dilated and greatly contracted bowel. The operation is practically the same in whatever part of the intestine it is performed.

The incision is made at the most convenient point over, and a little higher up than, the seat of disease; it should be not less than three inches in length. The entering and the leaving bowel being determined, convenient and suitable parts for approximation are fixed upon. The bowels, carefully isolated by means of flat sponges and sponge-cloths, are laid side by side for attachment. Four Lane's clamps are put on beyond the seats fixed for incision, after the intestinal contents have been forced upwards and downwards from between them.

The further steps of the operation will depend on the method of operative junction selected. The choice will probably be either by simple suture, or by Murphy's button, or by Senn's plates.

The method by suture is the same as that employed in side-to-side enterorrhaphy after enterectomy (see p. 628, Fig. 149).

So also with Murphy's button, the steps are the same as for gastro-enterostomy and require no further description. The large oval anastomosis button (Fig. 141) may or may not be employed.

With Senn's plates the operative steps are the same as those described for their employment in side-to-side junction in enterorraphy (Fig. 151).
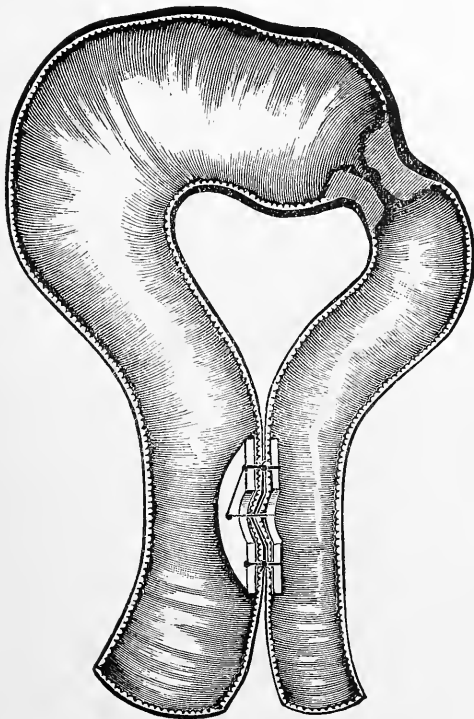
FIG. 151.

Intestinal Anastomosis by means of Senn's Decalcified Bone Plates.

The intestine is shown dilated and hypertrophied above the tumour which is causing obstruction, and contracted below. The plates are shown in position in half section.

The method of election would in my own case be simple suturing, because while being as safe as the other methods, it provides a much larger opening than any of them. As all such

openings tend to contract, the importance of starting with a large opening is self-evident.

The operation is seen at its best in the treatment of chronic obstruction caused by unremovable agglutination of intestinal coils by adhesions.   For cancerous obstruction in the colon colo-colostomy enters into competition with colostomy, and is greatly superior in results as it leaves no external artificial anus. For irreducible intussusception it would be employed only as a last resort, for it is inferior to other methods to be described. Altogether intestinal anastomosis must be regarded as a valuable addition to our means of dealing with an important, if not large, class of cases of intestinal disease.

Coeliotomy for Intestinal Obstruction.

History.
Conditions for which Operation is performed.
     Strangulation by Bands or through Apertures.
     Volvulus.
     Intussusception.
     Stricture.
     Foreign Bodies Inside Bowel.
     Compression by Tumours Outside Bowel.
Diagnosis of Intestinal Obstruction.
     General Symptoms.
     Diagnosis from other Diseases.
     Diagnosis of the Variety of Obstruction.
Indications for Operation.
The Operation.
     Anæsthesia.
     The Incision.
     Finding and Relieving the Obstruction.
     Removal of the Cause.
          In Volvulus.
          In Strangulation by Bands.
          In Intussusception.
          In Foreign Bodies.
          In Tumours.
          In Simple Stricture.
          In Unremovable Growths.
          In General Matting.
          In Gangrene.
After-treatment.

The relief of intestinal obstruction by Coeliotomy is, in most cases, of the nature of a herniotomy. If we regard an ordinary hernial sac as an artificial diverticulum of the abdominal cavity, and if the sac is opened during operation, we may regard such as

an abdominal section.   In internal hernia we operate without full knowledge of the site and nature of the obstruction ; it is not visible, very rarely tangible, and, in many cases, can only be inferred with a high degree of probability from rational symptoms.

History.—The question of operative treatment in intestinal obstruction has been discussed for centuries.   It is doubtful if the Greeks or Romans performed the operation.   Le Clerc, in his *History of Medicine*, tells us that Praxagoras advised operation in cases of volvulus* or intussusception ; and even incision into the gut to allow the fæces to escape, when the gut should be sewn up and the abdominal wound closed.   This is certainly very advanced treatment ; but it is more than doubtful if it was ever carried out.   Praxagoras was very fond of the use of emetics in intestinal obstruction : they did good, no doubt, by relieving the distended viscera of fluids and gas, just as Kussmaul's treatment does by the repeated use of the stomach-pump.   The injection of air per anum has been in use since the days of Hippocrates.   In later times bleeding was, of course, in constant requisition.

In more recent times, Bonet, who edited Barbette's work, writes a foot-note to his remarks on volvulus, that he has known an operation performed for volvulus with success.   I find the note quoted by M. Hévin, in a paper on "Gastrotomy" in the *Transactions of the Royal Academy of Surgery of Paris*, vol. 4, 1768 : "The baroness de Lanti, of Chatillon-sur-Seine, was nearly dead of an iliac passion.   A young surgeon who had served in the army for a long time came forward, and promised recovery if the patient would submit to operation.   He was allowed to operate. He pulled out a great deal of the intestine before he found the twist ; he freed it, *nodos dissolvit*, and returned it to its place.   He sewed up the abdomen, and the wound healed nicely, and the patient recovered."   The Baroness very properly settled a pension

* Up till comparatively recent times the term Volvulus was made to include all varieties of Intestinal Obstruction.   The word is simply the Latin equivalent of the Greek εἰλεός—the iliac, rolling or twisting passion, also known as "miserere mei."   The word has a purely subjective meaning, and has no relation to pathological anatomy.   The giving of an anatomical significance to the word "volvulus" is simply an example of the legion of modern medical linguistic barbarisms.

on this daring young surgeon, but he did not live long to enjoy it. Hévin considers that this may have been a case of hernia; but it is difficult to see why he should have to undo twists, and stitch up the abdominal wall, for a herniotomy. No doubt can be cast on another case, recorded by Oesterdykins Schacht, in which Nuck was the counsellor of operation. In this case the exposed intestines were carefully covered by warm milk while the coils were unravelled, and the patient also recovered. Most authors of the seventeenth and eighteenth centuries, with the notable exceptions of Hoffman and Felix Platerus, condemned the operation. Van Sweiten has been quoted as being favourable to Barbette's operation, and other names might be added. No doubt the operation was many times performed in the last two centuries, but with almost uniform failure; and this may have prevented the operators, in the face of the very general condemnation which it received at the hands of the greatest men, from publishing their cases. M. Hévin himself, in the article quoted, is by no means in favour of operative proceeding.

In the surgery of the present century, up to comparatively recent times, the operation had no history. It was either condemned or ignored. And even at the present day, in spite of the great advances in abdominal surgery and the increased certitude of diagnosis, there are many medical men who would consider it no discredit to stand by with folded hands while a patient is dying of an unrelieved internal strangulation of the bowels.

CONDITIONS FOR WHICH OPERATION MAY BE PERFORMED.

A full account of these conditions involves a description of all the forms of intestinal obstruction, with their differential and general diagnosis. The limits set to this work demand that such description be very short. And the need for it will not be felt by English readers, who have had provided for them the admirable manual by Treves on *Intestinal Obstruction*.

For clinical purposes, we may divide the forms of intestinal obstruction into Acute and Chronic: the one, where the symptoms come on suddenly in a patient who has shown no previous

symptoms of disease; the other, where the onset is more or less slow, or where there have been previous signs of intestinal disease. Thus classified, the varieties are:

Acute.

   I.   Strangulation by bands or through apertures.
  II.   Volvulus.
 III.   Intussusception.

Chronic.

  IV.   Stricture from disease in the wall of the gut, cicatricial or neoplastic.
   V.   Obstruction in the lumen; neoplasms, gall-stones, enteroliths, fæces, and foreign bodies generally.
  VI.   Obstruction from compression outside by tumours, &c.

I. Strangulation by Bands or through Apertures bears a close resemblance to ordinary hernia, not only in symptoms and causation, but also in treatment. The bowel is snared in an un-yielding opening, which obstructs the bowel and strangulates its vessels. The small gut is nearly always implicated.

Various forms of bands are described.

(1) *Isolated Bands of organised Inflammatory Material*—"peritoneal false ligaments," as they are called—are frequently the cause of strangulation. Such bands vary greatly in length, density, and thickness: sometimes they are round; often they are flat. Not infrequently several such bands exist, and cases are recorded where strangulation took place simultaneously under two false ligaments. The attachments of these bands present an almost endless variety. Frequently one end is attached to the mesentery, the other being inserted into any part of the peritoneum. Strangulation takes place either by the bowel slipping under the band, in which case it must be comparatively short; or by the bowel being caught in a twist or loop of the band, when it must be long. Sometimes obstruction is caused by the band dragging on the bowel and so causing kinking. The modes of constriction are so bewilderingly varied, that it is impossible to classify them.

(2) *Bands or Cords of Omentum* constitute another mode of constriction. The omentum becomes adherent to some spot in the peritoneum ; the whole, or part of it, is rolled up or twisted into a cord, which constricts the bowel, just as peritoneal false ligaments do. Omental bands are usually thick and vascular. They are found attached to any site where omentum can reach ; and that is, practically, anywhere. But they most frequently have an origin in some way connected with old herniæ. Multiple cords and multiple constrictions are more common with omental than with peritoneal bands. The greater length and mobility of omental adhesions render strangulation through noose or knot a more likely occurrence than with the peritoneal bands.

(3) *Strangulation by Meckel's Diverticulum* is of the nature of the preceding. Constriction may take place either when the diverticulum is attached to the umbilicus or when it has become adherent at some novel situation. In the former case, the tube may be wholly or partially obliterated. The diverticulum acts as a peritoneal or omental band by constricting gut which passes below it, or by forming loops in which the gut is snared. I have operated on a case where strangulation was caused by several coils of bowel passing between the abdominal wall and a partially obliterated Meckel's diverticulum. Mere dragging on the diverticulum, by causing kinking or setting up inflammation, may induce intestinal obstruction. False diverticula have not been found associated with the complaint.

(4) *Strangulation by Normal Structures which have become adherent* is also met with. Thus, the vermiform appendix, or the Fallopian tube, or the appendices epiploicæ, or even the bowel and the mesentery itself, may all be causes of intestinal strangulation. I have operated on a case where it was difficult to say whether the obstruction was caused by kinking from dragging on an old adhesion to the parietes, or by compression of a portion of bowel which passed over it.

(5) Strangulation may take place through *slits or holes* in the mesentery, or the omentum, or even in such situations as the broad ligament of the uterus and the suspensory ligament of the liver. Strangulation by the gut becoming caught in the foramen

of Winslow has been described. Mr. Treves* has operated on
such a case, but found it impossible to effect reduction. I have
operated on one such case in a patient of Mr. Alford, of Weston-
super-Mare ; and effected reduction with some difficulty. The
patient recovered. About fifty examples of retro-peritoneal or
mesenteric hernia, from the bowel getting entangled in the fossa
duodeno-jejunalis, have been described.

In the great majority of cases owning the above causes, the
small bowel is the part involved, and in most of these the lower
part of the ileum. The probability of site advances almost in
geometrical progression from duodenum to cæcum. The length
of intestine strangulated ranges from a mere nipping of part of
the calibre, to a capture of several feet. The average length is a
little over a foot ; but the limits are so wide apart, that any
average is misleading.

The mechanism of obstruction is essentially the same as in
external hernia. Simple entanglement, followed by congestion
and partial or complete obstruction, will explain many cases ;
others are completely strangulated from the outset ; a few, after
the bowel has been caught and held for some time, undergo
strangulation by a sudden and final twist or contortion. Senn's
recent experiments show that in circular constriction of the
intestine the immediate cause of gangrene is due to obstruction
of the venous circulation, and takes place at a point most remote
from the cause of the obstruction.

II. Volvulus is the name given to occlusion caused by
torsion of the bowel, or rotation round its axis of attachment.
In some cases, simple twisting is the cause ; in others, two
suitable coils become mutually intertwined. Volvulus is found
at the sigmoid flexure, in the cæcum and ascending colon, and
in the small intestine.

(1) *Volvulus of the Sigmoid Flexure* about its mesenteric axis is
the most common form ; two-thirds of all cases are of this
nature. The Ω-shape of this part of the gut, the length and
loose attachment of its mesentery, and its tendency to become

* *Lancet*, Oct. 13th, 1888.

overloaded and displaced by collections of fæces, explain its liability to volvulus. The bowel may be twisted once or twice, or even three times around its axis. In another class of cases the sigmoid loop, acting as a pedunculated tumour, becomes intertwined with a loop of small bowel, and induces strangulation of both.

(2) *Volvulus of the Cæcum*, or of the cæcum and colon adjoining, is easily understood. Mere acute flexure of the cæcum may block its passage; in such cases, however, there is usually some congenital malformation. In rotation of the cæcum upon itself, the colon is liable to be implicated, more especially if there is a long meso-colon. As with the sigmoid flexure, so here, obstruction may be caused by the intertwining of small intestine. Volvulus of the ascending colon is rare, and usually depends on anatomical abnormality. Volvulus of the cæcum may be subacute or chronic. I have treated with a medical colleague a case where, with only about half a rotation, there was enormous cæcal distension; the distended bowel occupied half the abdominal cavity.

(3) *Volvulus of the Small Intestine* is rare. It may arise from the simple twisting of one coil, or from the intertwining of two loops. An abnormally long mesentery, as from an old hernia, is a predisposing cause. The simple twist is usually through one complete circle, and is most frequently from left to right. Volvulus by the intertwining of two loops is very rare.

III. Intussusception or Invagination of the intestine means the prolapse of a part of bowel into the lumen of the part adjoining. It is the most frequent single cause of intestinal obstruction, constituting more than one-third of all cases. The pathological anatomy of intussusception is well understood and need not be dwelt upon. One portion of bowel catches another portion just above it, grasps it as if it were food, and pushes it along, invaginating more and more of it. The portion pushed inside, consisting of an entering and a returning layer placed peritoneum to peritoneum, is known as the intussusceptum. The sheath or containing bowel is known as the intussuscipiens. The

neck is at the entrance of the invagination, where the sheath joins the returning layer. Rare varieties are met with where double or triple intussusceptions take place, where a second intussusception is invaginated in a first, or a third inside both. A retrograde invagination, where a descending invagination is associated with an ascending one, is described.

When invagination is complete, adhesions form between the opposed peritoneal surfaces of the entering and returning layers, and these after a time become so strong as to render reduction impossible. Mere invagination need not cause obstruction ; it is only when the opening in the intussusception becomes incurved by the dragging of the mesentery, or the walls become swollen from congestion or inflammation, that obstruction takes place. The invaginated portion, as a rule, undergoes inflammatory changes, which end in adhesion of the intestinal cylinders; or have more pronounced results in rupture of vessels from intense congestion, causing discharge of blood by the rectum ; or even terminate in gangrene. Sloughing, with separation of the sphacelated portion, is found chiefly in cases of acute intussusception, though it is not uncommon in chronic cases. This sloughing, according to Senn, is caused by obstruction to the return of venous blood by constriction at the neck of the intussuscipiens.

There is a curious connection between epithelioma and intussusception. Most probably the epithelioma was the originator. The indurated mass gets caught in the bowel, is passed on as the apex of an intussusception, and there it continues growing. It is, however, quite consistent with what we know of the origin of epithelioma that it should have started in the ulcerating areas of the chronic intussusception. I have operated on a case in hospital where a fibrous tumour was the apex of the intussusceptum, a double one through the ileo-cæcal valve. Reduction was possible only after resection of the growth : the patient recovered.

Into the extremely interesting questions of the origin and cause of intussusception, I cannot here enter. I believe that many of the cases of acute colic produced by eating indigestible

substances are intussusceptions which right themselves. The frequency of intussusception of the dying is much greater than is generally supposed; if carefully looked for, at least one body out of four will show it on the post-mortem table.

Intussusception may take place—(1) in the small bowel, (2) in the colon or rectum, or (3) in the ileo-cæcal region. In the small bowel, it is found most frequently in the lower jejunum; and next in frequency, though in the proportion of one to four, in the ileum. The narrow calibre of the small bowel prevents any considerable amount of invagination; rarely is more than a foot engaged.

Intussusception of the large bowel may occur at any part of its course. But it is not common, and when it does occur it is small, particularly in the rectum.

The most common site of intussusception is in the ileo-cæcal region. Two varieties are here met with—the ileo-cæcal and the ileo-colic. In the former, the ileo-cæcal valve forms the apex of the intussusception, and passes up the colon, followed by the cæcum and the ileum. In the latter, the ileum, passing through the ileo-cæcal valve, is invaginated up the colon. A rare and complicated variety is, where a primary invagination of the end of the ileum is either passed through the valve into the colon, or invaginated into the colon along with the cæcum.

IV. Changes in the Substance of the Intestinal Wall may, by narrowing the lumen, be a cause of obstruction. Such changes may be of the nature of simple cicatricial stricture, or of new growths.

(1) *Simple Stricture* is produced by cicatricial contraction of organised inflammatory material replacing an old ulcer, or loss of substance, or following any chronic inflammation. Ulcers may originate in enteric fever, dysentery, or catarrh; peptic ulcer in the duodenum; syphilis or phthisis. As originating in chronic inflammation, stricture is seen in its most typical form in bowel that has been engaged in an old hernia. Any injury to the bowel may result in cicatricial stricture.

(2) Stricture may be caused by the development of *new growths*, malignant or benign. The malignant stricture is nearly always of the nature of epithelioma of the cylindrical variety; scirrhus and encephaloid are almost unknown. Epithelioma typically appears as a hard band embedded in the wall of the intestine, and constricting its lumen as if by a tightly-drawn ligature. The constriction is not always annular; sometimes it is in broad and diffused areas over a considerable portion of the intestinal wall. Thickening of the peritoneal and muscular coats is always present. Epithelioma of the intestine is practically always single and localised, and the mesenteric glands are late in becoming affected. As existing in the rectum, within the reach of the exploring finger, and treated by a special operation —colotomy—the disease will again come under review.

Sarcoma and lympho-sarcoma are rarely found as causes of obstruction.

New growths of benign nature—such as adenomata, tumours of pure fibrous tissue, or of fibrous and muscular tissue combined; fatty and vascular growths; and growths of a cystic nature* have all been known to cause obstruction: but they are by no means common.

V. Obstruction by a Foreign Body blocking the lumen of the gut is sometimes found. In this class must be reckoned the accumulation of fæces. Foreign bodies swallowed and becoming aggregated, gall-stones, and intestinal calculi or enteroliths, are causes of intestinal obstruction. Some polypi or pedunculated adenomata cause obstruction by their bulk in the cavity of the bowel.

In such cases obstructed circulation and strangulation of the bowel do not occur, and the symptoms in consequence are not, at first, very urgent.

VI. Compression of the Gut by Tumours outside of it forms a separate class. Obstruction may be produced in the

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* See Janicke and Buchwald, *Deutsche med. Woch.*, 1887, xl. Also Abstract in *Lond. Med. Rec.*, Nov. 15th, 1887.

most varied ways. I have seen a case where alarming symptoms of intestinal obstruction were produced by retroversion of the gravid uterus, pressing probably on entangled loops of small bowel. All sorts of growths—solid or cystic, or even abscesses in the peritoneal cavity—may press on the bowel and block its passage. Growths of the liver or pancreas may cause obstruction in the duodenum; tumours of the ovary, uterus, or pelvic bones, may compress the rectum; and the small bowel may be compressed by tumours in any part of the peritoneal cavity. Naturally, the less movable parts of intestine are most likely to suffer.

Usually such causes provide examples of chronic obstruction. The sudden displacement of a tumour may, however, produce sudden obstruction, with acute symptoms.

DIAGNOSIS OF INTESTINAL OBSTRUCTION.

In cases of acute obstruction, the onset is sudden; the symptoms from the beginning are urgent; and the result, after a rapid course, is almost uniformly fatal. Spontaneous recovery after volvulus is unknown; a very small proportion of cases of intussusception get well; and genuine examples of recovery after strangulation by bands or through apertures must be less common than in ordinary hernia, where the chance of recovery is practically considered as *nil*. In the case of the last, recovery takes place from gangrene of the gut, with the formation of false anus; in internal obstruction, gangrene causes certain death. There is a variety of intussusception which is chronic, and is not reckoned among examples of acute strangulation.

The symptoms are those of strangulated hernia, aggravated. Severe abdominal pain, collapse, vomiting, constipation, and abdominal distension are the leading symptoms. The pain is always severe and often agonising. It is frequently intermittent, and liable to exacerbations—possibly, as Treves suggests, on account of the intermitting nature of the constriction. The character of the pain varies: sometimes it is of the nature of severe colic, pure and simple; at other times, a sensation is

felt as if a band were drawn tightly round the abdomen. The site of the pain is not a trustworthy guide to the seat of obstruction.

Collapse, always marked, often alarming, attends every case of acute intestinal obstruction. We may expect to find the collapse most severe in cases where the onset is very sudden, and the patient is young and vigorous. Profound collapse suggests complete strangulation; but the degree of it is no guide to the amount of bowel involved.

Vomiting is always an early and well marked symptom. The irritated bowels soon become filled to distension with secretions, fluid and gaseous; and, under increased abdominal pressure and the constant contractions of the intestinal muscle, these secretions escape by the only possible exit—the stomach. Anti-peristalsis, or Dr. Brinton's well-known explanation of the process by the production of an axial and a peripheral current, may account for this vomiting. But such explanations are no more necessary to explain the regurgitation of the intestinal contents in the living than in the dead. Mere gaseous distension and increased abdominal pressure force the contents out of the mouth after death; and these passive causes, in addition to the very active one of intestinal contractions, may do the same during life.

The vomiting may or may not be attended with retching. Sometimes the fluids are ejected in great gushes without much straining effort. The vomit at first consists of the natural contents of the bowel; then, of bile-stained fluids; then, of dark grumous material—" coffee - ground "; and finally, of fæcal matter, more or less diluted. That fæcal matter may be vomited, even if the constriction is well above the large bowel, there is no longer any dispute; but we should not expect fæcal vomiting if the constriction is not below the jejunum. At first the vomiting may be of the nature of a reflex nerve symptom; later on, it is merely a mechanical discharge of accumulated secretion, and the existence and continuance of such vomiting affords relief to the patient.

Constipation, absolute and insuperable, is an important sign.

Occasionally at an early stage of the complaint, fæces are passed from the bowel below the seat of constriction; but when the disease is well established, neither fæces nor flatus pass. Discharge of blood by the anus is found in a considerable number of cases of intussusception.

Abdominal distension, from the accumulation of gas and fluid, is an early and prominent symptom. It increases with the duration of the illness; and in marked examples the parietes may be tense, like a drum, and visibly white and glistening from being stretched. In such cases mechanical obstruction to respiration is present. Tympanitic resonance all over the abdomen, except perhaps in the flanks, is marked.

It need scarcely be added that, in making the diagnosis, all the usual sites of external hernia must be explored, and the rectum must be digitally examined.

The *Diagnosis from other Diseases* is not often difficult. A localised paralysis of the gut, from inflammation of its walls or from nerve disturbances, may produce symptoms very similar to those of intestinal obstruction. A bruise or crush of the bowel, and inflammation after reduction of a strangulated hernia, are practically varieties of obstruction. Descending testicle becoming incarcerated or inflamed is well known to cause symptoms like those of obstruction. I have been called to treat a man aged 76 for urgent symptoms of obstruction, which were found to be produced by inflammation in a testicle, which lay undescended in the inguinal canal, and I have seen similar cases in hospital practice.

Acute peritonitis may be mistaken for intestinal obstruction; in fact, the mistake has been made on not a few occasions. If peritonitis is caused by perforation, the symptoms may be most misleading. A few hours will, however, make the diagnosis clear. The temperature is no guide; the worst cases of peritonitis may have a normal, or even subnormal, temperature. The nature of the onset, the character of the vomiting, the quality of the pain, and, most important of all, the palpation of the abdomen, will also guide us. Lead colic, accompanied as it often is with obstinate constipation, and renal or hepatic colic,

where pain, collapse, and vomiting may be present, might also be mistaken for intestinal obstruction.

The *Diagnosis of the Variety of Obstruction* may be attended with considerable difficulty. It is nearly always possible to say whether the case is one of acute or of chronic obstruction; the difficulties appear in the diagnosis of the individual variety.

A chronic case, in which the primary symptoms have been obscure, may suddenly become acute. The terminal symptoms of all cases of obstruction are very similar.

The *Symptoms of Acute Obstruction* are as follows: The patient, in ordinary health, is suddenly seized with severe abdominal pain of a griping character, with exacerbations. He is at once prostrated, suffers from shock, and his face indicates the patient's consciousness that he is seriously ill. Vomiting very soon follows the first attack of pain, and continues at irregular but short intervals. There is absolute constipation, and abdominal distension which goes on increasing with the duration of the malady.

It must be noted that acute symptoms occasionally supervene on chronic causes; and the reverse, to a more limited extent, holds true.

The diagnosis of the *Variety of Acute Obstruction* may often be successful.

Strangulation by Bands.—The patient is probably a young male adult, who will usually have a previous history of peritonitis. In a few cases a previous attack of obstruction, partial and mild, will be recorded. The disease will have attacked him suddenly, and without warning, in the midst of his ordinary pursuits. The pain, which from the beginning is severe, is continuous, with exacerbations, and is usually located in the region of the umbilicus. There is no tenderness on pressure. Vomiting soon comes on, and is frequent and copious. In more than half the cases, it becomes stercoraceous about the fourth or fifth day. From the first constipation is complete. No blood is discharged. Extreme prostration, or even profound collapse, may be present from the beginning; usually it is most marked at the onset, and becomes less marked afterwards. Abdominal

distension is not at first a marked symptom. No tumour is felt on palpation.

Such cases die about the fifth or sixth day.

Volvulus of the Small Intestines presents symptoms very similar to the above. *Volvulus of the Colon*, nearly always at the sigmoid flexure, presents more distinctive symptoms. It is usually found in males, after the age of forty, who have suffered for some time from constipation. Pain comes on at once, but it is not so severe as in strangulation through bands, and it frequently intermits. Occasionally the pain is referred to the hypogastrium or the back. Tenderness on pressure comes on as the disease continues. Vomiting comes on late, or not at all, and is never very urgent. In only fifteen per cent. of the cases does it become fæculent. Prostration is never extreme. Constipation exists from the first.

A distinctive symptom is a rapid and excessive accumulation of gas, which soon causes great distension of the abdomen.

The average duration of life is about six days.

Acute Intussusception usually appears in children. Pain is a prominent symptom; it comes on in waves, reaching a point of great intensity, and then subsiding. Vomiting is a very variable symptom: sometimes it is present from the onset, and is copious and frequent; at other times it comes on late, and is never severe; a few have no vomiting at all. The most characteristic sign is the discharge of blood by the rectum, frequently attended with diarrhœa and tenesmus. A definite tumour is frequently palpated through the parietes; and, in intussusceptions affecting the large bowel, the apex of the invaginated bowel may be felt through the rectum. Abdominal distension is usually absent; occasionally the abdomen is retracted.

These cases may be fatal within twenty-four hours; or they may last for several days; or they may become chronic, lasting for weeks.

The *Symptoms of Chronic Obstruction* need not be detailed. They are simply those of acute obstruction in a milder form, and prolonged over a longer period.

Stricture of the Small Bowel may be taken as representative of a large class of cases whose symptoms are broadly as follows. In such there is usually some previous history of intestinal trouble, followed at a considerable interval by attacks of obstruction, gradually increasing in gravity till the final attack which jeopardises the life of the patient. Pain comes on in paroxysms, and completely intermits : not infrequently it appears after eating. Vomiting is not an urgent symptom ; it is late in coming on, is neither frequent nor copious, and rarely is fæculent. Constipation, not absolute, or alternating with diarrhœa, will be present. Before the final attack, the patient will have lost flesh and spirits. Abdominal distension is replaced by attacks of flatulence, more or less distressing ; but never, except at the end, causing dyspnœa.

Such cases may last for a month or more. In most cases, however, more or less acute symptoms supervene on the chronic, with corresponding curtailment of the duration of life.

It is rarely possible, unless a distinct tumour is felt, to diagnose simple from malignant stricture. The history may be of some assistance, however. Anything which causes gradual obliteration of the bowel, tumours outside or inside, contracting adhesions, and all such conditions, may produce identical symptoms.

Stricture of the Large Bowel has most features in common with stricture of the small bowel. There are the same irregular beginnings, and the same exacerbations, with occasional intermissions. Vomiting is less frequent in stricture of the large bowel. Distension is, however, always a marked, and often a very troublesome, accompaniment ; and tenesmus, with the discharge of blood, mucus, or pus, is often found.

In cases of chronic obstruction, and in many acute cases, the aids of vision and auscultation are valuable. Waves of intestinal contraction may be visible through the parietes. These start at the seat of stricture and work upwards. The most distended bowels and the most violent contractions are just above the stricture. By auscultation, revealing gurglings more loud and more prolonged than anywhere else in the abdomen, we may

locate the seat of obstruction more easily in chronic than in acute cases. Exposure to air and handling of the parietes promotes intestinal contraction, and thereby promotes the possibility of diagnosis by vision and by auscultation.

As cancer of the rectum, malignant stricture is perhaps the best known of all causes of intestinal obstruction.

Fæcal Accumulations have some special features of their own. They occur chiefly in women who have passed the prime of life, and, more particularly, in lunatics. The symptoms are simply those of constipation, becoming more and more intractable. There is usually a palpable, or even visible, tumour having the characters of fæces. The abdomen becomes generally distended with gas or fæces, or both. Pain of a paroxysmal nature supervenes. Vomiting is late in appearing, and is long in becoming fæculent. There may be a history of previous attacks.

This is about as far in differential diagnosis as our present knowledge will carry us. Individual variations of symptoms must be allowed to each case on a liberal scale. The differences between a cumulative and an instantaneous cause,—between strangulation and mere obstruction; between obstruction in the small bowel and obstruction in the large bowel,—theoretically marked enough, are found in practice to be very difficult of detection. But, by a careful summation of the concrete symptoms in each case, it will nearly always be possible to form a tolerably correct opinion as to the exact nature of the obstruction, and to formulate, either at once or after waiting a few hours, a consistent and definite plan of treatment.

INDICATIONS FOR OPERATION.

The indications to operate in any given case depend, in the first place, upon the chance which the patient has of getting well without operation; and, in the second place, upon the degree of probability with which success will follow the operation.

To cases of acute obstruction there is practically but one termination—death. No case of volvulus, whether of large or

small intestine, has as yet been known to recover under treatment purely medicinal. Spontaneous recovery, in the numerous class of cases of strangulation by bands, is not to be looked for. In the case of intussusception, where we have been accustomed to look for favourable results without operation, it seems to me that Treves has made out a clear case against expectant treatment. Looked at from the side of causation, or actual pathological condition, there is practically no expectation of recovery. Certainly ninety-five per cent. of all such cases die.

Here, then, the indication is clear enough—as clear as the indication to tie a bleeding carotid—operation. In the sense of avoiding the risk of death, the indication is more definite than in external hernia; for in hernia there is a chance of recovery by gangrene. In the sense of promoting the chances of recovery, the indication is not so strong; for more cases of external herniotomy must always recover, than of internal. The risks are increased in the same way by waiting, and by handling or purgation—which are almost the same in evil effect. There is but one treatment—release of the strangulated bowel from the strangulating band.

From the pathological standpoint, it is easy enough to be definite; but not so from the diagnostic. We are too seldom certain of the diagnosis, to be always dogmatic as to the treatment. But if we are doubtful whether we can do good by operating, we may be certain there are many ways of doing harm by administering drugs. There never yet was a case of true intestinal strangulation in which purgatives did not do harm; and not one out of ten escapes purgation. Emetics may do good; even bleeding may not do harm; but certainly purgation is baneful. I say nothing about manipulation of the abdomen under an anæsthetic. The cases of success recorded certainly do not read like cases of acute obstruction. But manipulation early in the case ought to be less harmful than purgation.

At once, or within a few hours, we ought to make a definite diagnosis. If we are convinced that it is acute obstruction, then operation should be performed at once; if we are convinced

that it is not, another treatment equally definite ought to be pursued. From the beginning a definite plan of treatment ought to be laid down, and this plan ought to be adhered to. Let it be either drugs or operation, and never that fatal compromise— operation when drugs fail.

The indications for operation in chronic and sub-acute cases are by no means fixed and definite. Generally speaking, when, in a chronic case, we find that in spite of careful dieting and treatment the attacks of obstruction become more numerous and more severe, and finally if one attack supervenes which is positively insuperable and is rapidly killing the patient, then operation is indicated. But, with this, some conception must be formed as to the nature of the operation, and the probable ultimate effects of it. Thus, in the case of peritoneal cancer obstructing the gut, uncertainty as to the amount of bowel involved, and the certainty of early death in spite of operation, would make operation scarcely justifiable. Cases of fæcal accumulation sometimes recover after the patient is apparently *in extremis*, with obstruction lasting, perhaps, for weeks; and, in such, operation is rarely indicated. In chronic intussusception, the question of operation is very difficult to settle. It is true that cases may have gone on for weeks without the formation of strong adhesions, rendering reduction impossible; but this chance is not to be reckoned upon. If the invagination cannot be reduced, resection in the manner to be described must be resorted to.

In many cases of stricture the question of resection of the bowel will arise : this has already been considered under Enterectomy. In the case of foreign bodies in the bowel, treatment must be guided by the urgency of symptoms pointing to obstruction, or to ulceration and inflammation, and the proved inefficacy of other means of treatment.

Some discussion has taken place as to whether it is advisable to perform coeliotomy for intestinal obstruction if peritonitis is present. Such a discussion is of an arm-chair nature—a reasoning away from the facts. Peritonitis is present in every case of true intestinal obstruction : it may be local or wide-spread, and

it may be serous, plastic, or purulent. It is an essentia.
concomitant of the disease. In a marked case of intestinal
obstruction, I doubt if the separate diagnosis of peritonitis is ever
possible. In any case its presence can be no contra-indication
to operation. On the contrary, if other circumstances do not
forbid it, I would regard peritonitis as a positive indication.
It would be just as valid to argue against the performance
of herniotomy because there was fluid in the hernial sac, as
against coeliotomy for obstruction because there was fluid in
the abdomen.

Mortality and Appreciation.—The death-rate of coeliotomy for
intestinal obstruction is high, probably more than 70 per cent.
Large collections of cases by Schramm and by Curtis give a
percentage death-rate of something between 62 and 69. Even
thus the operation would still be justifiable ; for nearly every
case which recovers may be reckoned as saved from death, and
the deaths are only hastenings of the natural termination.
There can be no doubt that delay is the chief cause of mortality.
We know how successful early herniotomy is : surely, in the face
of recent exploits in abdominal surgery, early coeliotomy for
intestinal strangulation ought to be only a little less successful.
Before abdominal distension has come on, before the bowel has
become inflamed, and before the patient's strength is exhausted,
I have no hesitation in affirming that, in competent hands,
coeliotomy for intestinal obstruction would not have a mortality
above 20 per cent. In a personal experience including over
110 operations the mortality has been nearly 40 per cent. In
the last 30 cases there have been 6 deaths.

THE OPERATION.

The details of the operation include what is common to
all cases of obstruction, and what is special to each variety.
Some of the special proceedings are comparatively trivial ; these
will be described in the general account : others are of great
moment, and these will receive separate consideration.

Anæsthesia.—These patients are rarely promising subjects for anæsthesia. The surgeon is usually called in late, when the patient's heart is very weak, and his stomach and intestines are full of fluid. Vomiting, liable to occur during the anæsthetic, is full of danger: I have lost two patients on the operating table from this cause. The vomited fluids are drawn into the lung and cause death by suffocation. It is often a question whether the stomach should not be first emptied by the stomach-pump. The mere administration of an anæsthetic is often followed by alarming symptoms: in a few minutes, though the operation may not be severe or prolonged, the condition of the patient may be changed from one not very serious to one positively alarming. This fact has so strongly impressed me that, in a bad case, with distended abdomen, I should always operate without general anæsthesia; make the incision, a very short one, after a local injection of cocaine, or after freezing; be content with a short exploration, and, if the cause were not found, make an artificial anus. The operation may subsequently be completed when the patient is out of danger. Enterotomy with local anæsthesia is a very simple affair; general anæsthesia with an exploratory coeliotomy is a very serious matter in an exhausted patient whose hollow viscera are distended with fluid and gas.

In this operation we have specially to bear in mind that the prime object in surgery is, not merely to perform a scientific and technically complete operation, but to save the patient's life. An operation for intestinal obstruction is certainly not completed till the cause has been removed; but if the cause can be removed only after a prolonged and difficult operation at the expense of the life of the patient, then I maintain it is better to temporise, save the patient's life by enterotomy, and remove the constriction afterwards when the patient can bear it. In every *very* bad case I should begin by putting the patient out of immediate danger, by the performance of enterotomy without general anæsthesia: as soon as he can bear it the cause of strangulation may be sought for, and the operation completed.

The Incision.—As we are rarely certain of the site of obstruc-

tion, we must adopt a form of incision which will give the
greatest range and freedom for exploration and operation.   This
is a median incision, about midway between umbilicus and pubes
if the abdomen is much distended, and nearer to the umbilicus
if there is little distension.   The incision is adopted merely for
its convenience in exploring ; there is no strong anatomical
reason against adopting any other site.

   The incision is made long enough to admit two fingers.
When the sub-peritoneal fat is reached it bulges into the
wound, being pushed outwards by the distended bowels.   Tait's
plan of opening the peritoneum, by pulling it outwards between
pairs of catch-forceps and dividing the raised fold between
them, is the best.   If the membrane is thin, I prefer to pinch
it up between the finger and thumb, roll it about to see that no
bowel is included, and make a small opening at the top of the fold
with the scalpel.   The opening is enlarged by scissors, upwards
and downwards, to the extent of the external wound—that is,
to about two inches.   Bleeding will have been checked in the
ordinary way.   If afterwards found necessary, the incision may
be prolonged.

   Finding and Relieving the Obstruction.—The plan usually recom-
mended is as follows.   The hand, inserted through the wound
(for this purpose the incision must be longer than that recom-
mended), is first carried to the cæcum.   If it is found much
distended, we may expect to find the cause lower down some-
where in the colon.   The hand follows the course of the ascend-
ing, transverse, and descending colon to the sigmoid flexure,
seeking the cause of obstruction on the way.   If it is not in the
colon, we seek for it in the small bowel ; and for this purpose,
we are told to find and follow up the collapsed bowel below the
obstruction.   Lastly, the region of the umbilicus and the
promontory of the sacrum, as being likely spots, are explored.

   Now, these are excellent directions, from the pathologist's
point of view ; and they would be easily enough carried out
if the bowels were not distended, and the abdominal walls not
hard and tense.   To explore the whole length of the colon

through tense parietes and over dilated bowels would require that the arm be inserted half-way up to the elbow—particularly if, as is often the case, the transverse colon is pushed upwards under the diaphragm. And to follow up individual coils of the small bowel with the hand is no more easy : if it is possible at all, it is tedious and difficult in the extreme. The finding of collapsed bowel would be of assistance : but, as often as not, there is no part of the bowel collapsed ; it is only less distended than another part. The passing of the bowel along inch by inch will certainly expose the obstruction, but it will probably kill the patient.

I believe that the best means of reaching the seat of constriction will be by inspection of the bowel presenting at the wound. There is a high probability, wherever the cause lie, that the most dilated coils will rise nearest to the surface; and, the greater amount of bowel being within three inches of the umbilicus, there is a further probability that the most dilated coils will be within sight. Very gently they may be moved first on one side, then on the other, as well as upwards and downwards. The most dilated portion, which will be also the most congested or not far off it, is fixed upon and followed in the direction of increasing distension and congestion, wherever that may lead. It will certainly lead to the stricture. The whole manipulation may be carried out with two fingers. If, now that the obstruction and the nature of it are discovered, it seems necessary to prolong the incision to relieve it, this can be done in the direction which is most convenient.

Should this method not succeed (it has rarely failed in those cases on which I have operated), I should then recommend the insertion of the hand to explore. Should this also fail, I should recommend that the most distended portion of bowel be permitted to extrude under a large flat sponge, wrung out of warm antiseptic lotion. One end of the loop will extrude less readily than the other, and one end will appear to become increasingly congested ; these characters are sure guides to the seat of obstruction. When the bowel begins to show that it is fixed inside the abdomen, or when the evidences of congestion

are striking, the finger inserted along this portion of bowel will detect the origin of the mischief.

This protrusion of bowels has a purpose other than the providing of more space for discovering and treating the cause of obstruction. It will be called for only in cases of great intestinal distension; and excessive distension I believe to be a condition which requires relief almost as urgently as actual strangulation. This distension can be relieved only by puncture or incision when the bowel is extruded.

The plan of permitting bowels to protrude has been very generally and very heartily condemned. The condemnation, however, has been in the spirit of the peritoneal surgery of the last generation, rather than of the present. In the face of the actual practical work now successfully carried out, it is idle to argue that extrusion of the bowels, properly managed, is a source of serious danger. Less damage is likely to be inflicted on bowels by a soft sponge or sponge-cloth lightly resting on them, than by a rough hand pushing them about under great pressure inside the abdomen. The chief objection to protrusion of bowel is the supposed difficulty of returning it. If in any case it is proper to return it, it is not very difficult to do so. An assistant hooks a finger of each hand under the ends of the incision, and pulls the parietes forwards; the surgeon spreads both hands over the sponge which covers the bowels, and by steady gentle pressure forces their contents into the bowels inside the abdomen. When empty and collapsed, the extruded bowels are readily returned.

But it is not always proper to return distended intestine into the abdominal cavity. I hold, on the contrary, that no operation for intestinal obstruction is properly completed if the patient leaves the operating table with a greatly distended abdomen. The effects of distension are doubly deleterious—on the system generally, and on the bowels themselves. That dyspnœa, palpitation, and what may be called abdominal shock, follow great distension of the abdominal cavity is well enough known. That paralysis may, and does, follow over-distension of a viscus such as intestine, whose contraction depends on involuntary muscle in

its walls, is also known. But it is not generally recognised that the mere presence of an excess of fluid or gas in the intestine is in itself an efficient cause of obstruction. When the intestine, confined by mesentery and by the limits of the abdominal cavity, is fully distended, it does not form gentle curves, but acute flexures ; at these flexures the intestinal walls on the mesenteric side encroach on the lumen, so as to form valves which obstruct the passage of contents. Even when the intestines, artificially distended in the deadhouse, are removed from the cavity with the mesentery attached, and laid on the table, they do not empty themselves. The disappointing results of simple tapping of the bowels are thus explained : the gut is emptied down to the second or third flexure, and no further. These views, founded on observations during operations and on experiments in the deadhouse, have recently been incidentally confirmed by certain experiments of Senn on inflation of the intestine with gas. Of their truth and of their importance there can, I think, be no question.

Further considerations in support of this view may be brought forward in the practical benefits derived from Nélaton's operation of enterotomy and Kussmaul's treatment by artificial emesis. Many cases of cure by enterotomy, which is nothing more than drainage of intestinal contents, have been recorded. And already a considerable number of cures by drainage through the œsophageal tube (Kussmaul's plan) have accumulated.* The relief that vomiting affords is evident in every case of intestinal obstruction. There can be no doubt that, as Senn puts it, " great distension of the stomach constitutes an important factor in causing or aggravating intestinal obstruction, as it effects compression, which again causes impermeability of the intestines, or aggravates conditions arising from an antecedent partial permeability, by producing sharp flexions among the distended coils of the intestines." No one, experienced in abdominal surgery, can fail to have observed the dangers of distension, or to have appreciated the benefits of getting rid of intestinal fluids and gases.

* See in particular, Rhen, *Centralbl, f. Chir.*, July 23rd, 1887.

I would therefore, in every case of coeliotomy for intestinal obstruction with distension, consider evacuation of the intestinal contents as an essential part of the proceeding.

To open the bowel, it is best to make an incision by a scalpel transversely to its axis at the point most distant from the mesentery. A trocar and cannula, large enough to permit outflow with sufficient rapidity, would make a ragged, bruised wound, not so suitable for being dealt with by suture, and not so likely to heal kindly, as a simple incision. The bowel, properly protected, is pulled a few inches away from the wound, and held over a vessel by both hands, while an assistant gently kneads the sides of the abdomen to force the fluids along the bowel and up to the opening. The first flow of gas and liquid rushes out with considerable force, and a notable diminution in the size of the abdomen will at once be apparent : artificial pressure, however, is wanted to empty the rest of the bowels. Of course, the bowel that had been constricted will have been carefully examined to see that there is no chance of its being ruptured in the manipulation. But the operation having, on the whole, an effect of relieving the bowels of tension, need not be regarded as endangering the continuity of the intestinal walls. When the bowel is sufficiently empty, the opening is carefully closed by a continuous catgut or silk suture, including only peritoneum, muscle and sub-muscular fibrous tissue, in the ordinary manner. In those cases on which I have operated in this way I have used a double continuous suture, simply repeating the process with the same thread in the opposite direction. Any peritoneal fluid is to be mopped out, and the case generally treated as an ordinary abdominal operation.

The proceeding of evacuation and drainage of intestinal fluids occupies some time, and as prolonged anæsthesia is full of danger, I have recommended that it be carried out after anæsthesia has been stopped. The painful parts of the operation — the parietal incision, the abdominal manipulations and the introduction of the stitches—are performed while the patient is under the influence of the anæsthetic : these steps should occupy only a few minutes ; the patient is then permitted to

recover consciousness while the surgeon proceeds to carry out the painless steps associated either with simple evacuation or enterostomy. At least half an hour, probably an hour, or even longer, will be occupied in completely emptying the intestines. The surgeon may sit down on a chair by the bedside or operating table, watching and encouraging the process. The piece of bowel drawn out of the parietal opening is covered with several thicknesses of sponge-cloths, only the part from which evacuation is taking place being exposed. At varying intervals fluids and gases escape in great quantities, and may be conducted into a suitably placed vessel by means of a long piece of rubber tubing. When the abdomen is flat the opening in the bowel is closed, the bowel is cleansed and returned, and the parietal sutures, already placed, are tied. If it is decided to keep the intestinal opening pervious, the bowel is fixed in the wound in the manner to be described under Enterotomy.

These remarks are left almost as they were written for the third edition of this work, and absolutely as written for the fourth. Evacuation and drainage of intestinal contents are now so fully established as a mode of treatment in cases of intestinal distension from whatever cause arising, that it may almost be considered as a special operation. I have therefore decided to class it under " Enterotomy " or " Enterostomy," and there will be found a detailed description of the methods employed for all cases where evacuation is extended into drainage.

Removal of the Cause of Obstruction.—The surgical proceeding for the relief of the constriction varies according to the cause of it. In most cases where coeliotomy is performed, the removal of the cause will consist in the division of a band, the enlargement of an opening and release of the bowel, the untwisting of a volvulus, or the drawing out of an intussusception. In all it may, as already indicated, be advisable to incise the bowel and draw off its contents. But in some cases it may be necessary to resect a piece of gangrenous or diseased bowel—enterectomy. In others it will be advisable to leave an intestinal

fistula—enterostomy or enterotomy. These, and other allied special proceedings, will receive separate consideration. Here we consider the special modes of proceeding with the individual forms of constriction.

In Volvulus.—The unravelling of a volvulus of the small intestine, especially if it is caused by the intertwining of two coils, must frequently be a matter of considerable difficulty. Volvulus of the sigmoid flexure is still more difficult to deal with. At an autopsy which I performed on a case of volvulus of the cæcum, I could not, though the incision extended from sternum to pubes, undo the twist. Mr. Treves has had a similar experience with volvulus of the sigmoid flexure during the life of the patient, and found much difficulty in righting matters after death. In another case, on which I operated, I was able to reduce a volvulus of the cæcum, and, with the aid of enterotomy, to save the patient's life. In a second case on which I operated in the Bristol Infirmary, a volvulus of the small bowel was found, but could not be reduced till the whole was removed from the abdominal cavity. The bowel was twice twisted on itself, and when uncoiled, at once collapsed, the contents flowing downwards. At the end of a week, symptoms of recurrence of the volvulus appearing, I performed enterotomy without chloroform, fixing the bowel to pieces of strapping around the wound. The patient for nearly a year wore a catheter in the opening, through which he passed flatus along a tube into a bottle which he carried in his pocket. Now the necessity for the catheter has passed, the opening is closed and the patient is quite well. Since then I have lost a case of volvulus in which I did not fix the bowel and do enterostomy. I re-opened the abdomen, found the volvulus had recurred, and did enterostomy, but it was too late. The rapid distension of the gut in volvulus, the early occurrence of peritonitis, and the complications which frequently accompany the condition, sufficiently explain the difficulty met with in reducing it.

Such cases left to themselves are hopeless, and a strong effort should be made to bring success to the operation. As soon as it is evident that it is impossible to reduce the twist, the

distended intestine, pulled out through the incision, ought to be opened at the highest part of the curve, and emptied of its contents. After this, reduction ought again to be attempted. If it succeeds, the opening in the bowel may be sutured and the abdominal wound closed. If it does not succeed, an artificial anus must be made in the first convenient piece of bowel above the volvulus. Resection of the affected gut has been suggested; but such a proceeding can scarcely be contemplated unless the volvulus is small, in which case reduction is less likely to fail. Intestinal anastomosis in a suitable case may well be employed in the permanent cure of volvulus of the large intestine or sigmoid flexure, if not too low down.

In Strangulation by Bands and through Apertures.—The removal of a constriction belonging to this class is not usually a difficult proceeding. A peritoneal adhesion may be readily tied in two places by suitable ligatures, and divided between them. They ought to be tied as close as possible to their sites of attachment; as, if they are left long, they may give trouble at a future period. The same treatment ought to be applied to omental cords: they ought to be tied close to their point of origin, and cut off short. If, as is sometimes the case, the cord is very thick, it may be tied by transfixion in two portions; it will rarely be necessary to tie individual vessels. Sometimes there exists a second band, causing strangulation; a good few cases are recorded where death was caused by an overlooked second strangulation.

In dealing with a Meckel's diverticulum, we must ascertain whether we are dealing with bowel, or the still pervious rudiment that goes to the umbilicus, or a simple inflammatory band. The band is treated as are other bands. When we have to deal with a pervious tube, we may, according to its size, be content with mere division as low down as possible; or we may, at the end next the bowel, have to make the closure as carefully as we should for any other opening into the bowel. Though there is a remote danger in leaving a diverticulum, there may be a still greater immediate danger in removing one if it is large; and its removal involves the making of an opening of a considerable size. It ought to be removed at a point where it is perceptibly

diminished in size. The best mode of closure would probably be by pushing inwards the mucous membrane, and ligaturing the fibrous coat outside it. If the opening appears to be too large to be treated in this way, it may be closed by the Lembert suture, or any other plan most affected. In a case on which I operated with pervious diverticulum about as thick as a crow-quill, I was content with simple ligature and careful disinfection of the mucous membrane. In another case I cut the diverticulum off short and turned it inwards on the bowel after closing it with a purse-string suture, suturing the bowel over the inverted stump.

If the appendix is the cause of constriction, we should completely remove the appendix. In one such case on which I operated (with Dr. Evans, of Cardiff) there had been several attacks of appendicitis before obstruction came on, and a coil of bowel was caught and strangulated under the appendix adherent to the parietes by its tip. It must not be forgotten that the mesentery (so callèd) of the appendix sometimes contains a goodly sized vessel.

The Fallopian tube, adherent, as a cause of strangulation, may be treated as a simple band, and divided as such with safety ; though it is perhaps better to try and limit the division to the inflammatory new tissue.

In all such cases, the gut will be carefully examined before the abdomen is closed. If it is much distended, it will be incised and emptied at some distance from the site of constriction ; if it is gangrenous or on the point of becoming perforated, this part must be excised in a manner to be described.

In Intussusception.—In most cases diagnosed as intussusception, a full trial to inflation, injection of fluids, or some such means, will have been instituted, before abdominal section is thought of. It seems, from Treves's investigations, that spontaneous cure by separation of the gangrenous intussusceptum is a very rare event indeed ; and cure, after any plan not operative, would seem to take place with far less frequency than is popularly supposed. With early operation, coeliotomy for intussusception, involving as it does nothing more than merely pulling out the intussusceptum, ought to be one of the most

successful of abdominal operations : when postponed till adhe-
sions have formed, and a large amount of gut has become
invaginated, it may be impossible to reduce it. In 51 operations
collected by Braun, attempts to reduce the intussuscepted gut
succeeded in 26, and failed in 25 ; and 16 of these 26 cases sub-
sequently died. Operation should not be delayed beyond the
second day. At an autopsy, it will be usually found that the
bowel will give way before the intussusceptum is pulled out. I
have failed at operation to reduce a very large intussusception
of three days' standing in a child a year old. I have succeeded
in the case of an adult after five days. In chronic intussuscep-
tion, which is usually a repetition of acute attacks, reduction is
less likely to fail.

For reduction, the entering bowel ought to be grasped as
closely as possible to the invagination, and the other fixed point
ought to be the bowel just beyond the end of the intussusceptum ;
with traction is associated a gentle process of kneading. To
catch the edge of the intussusception close to the entrance
would be to force it down on itself and cause compression of the
intussusceptum, and thereby increase the difficulty of reduction.
The reduced bowel must be scrutinised most carefully, to see
that there is no laceration or gangrene.

If the intussusception cannot be reduced, several plans have
been recommended : firstly, resection of the whole with suturing
of the divided bowels ; secondly, resection, and the formation of
an artificial anus ; thirdly, formation of an artificial anus, without
resection. A fourth plan which has been recommended is to
form an artificial anastomosis between two portions of bowel
above and below the intussusception. The first can be done
only where the intussusception is comparatively small, not
involving more than three or four feet of bowel ; the second,
usually preferable to the first, is similarly limited in application ;
the third may be used, as a last chance, where neither resection
nor reduction is possible. The fourth plan, of exclusion of the
intussusception, and anastomosis of bowel above and below the
obstruction, would be facilitated by the use of Senn's decalcified
bone plates or some similar contrivance. In an infant on whom

I operated unsuccessfully, where quite half of the small bowel lay inside the colon and could be felt through the anus, resection was, of course, out of the question. I made an artificial anus above, and fixed the bowel with catch-forceps, so that more might not be dragged into the wound.

A fifth plan, which is, in my opinion, the best of all, is that of Barker of University College, London.* The principle of his operation is to excise the intussusceptum through a longitudinal incision in the intussuscipiens and to suture the already adherent bowels at the neck. The steps of the operation are as follows: At the point where the intussuscipiens receives the intussusceptum (A, Fig. 152) the two portions of the bowel are at once united by a continuous circular suture of fine silk, taking up the serous and muscular coats and carried on to the mesentery. An incision, two inches in length, is then made longitudinally through all the coats of the intussuscipiens on its free margin. This gives access to
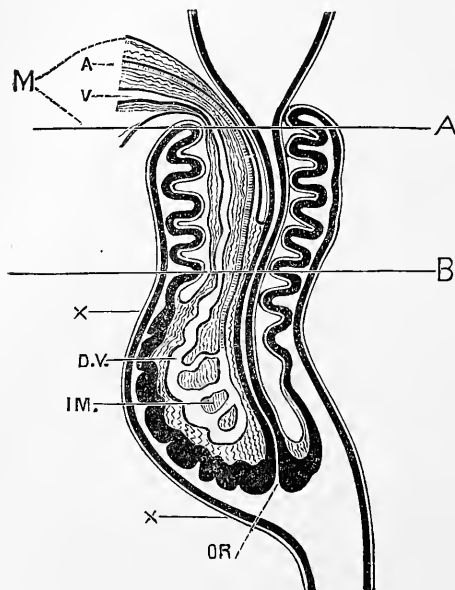
Fig. 152.

Diagram of Vertical Section of Intussusception, from an Actual Specimen.

M. Mesentery.
A. Artery.
V. Vein.
D.V. Dilated vein.
IM. Inflamed mesentery.
OR. Orifice of bowel at apex of intussusceptum with thickened mucous membrane around.
A. Line drawn through usual seat of adhesions.
B. Line for resection of intussusceptum.
X.——X. To mark the ends of the vertical incision in the intussuscipiens through which resection is made.

* *Lancet,* January 9th 1892, p. 79.

the intussusceptum within. The latter is then drawn out through this incision and is cut across close to its upper end; or, if too long to be first drawn out, it may be cut across *in situ.* A few stout silk sutures are, however, passed through all the walls of the stump as the mass is gradually cut off, and are tightly tied so as to keep the serous surfaces in contact and control all bleeding from the vessels entering it at the mesenteric attachment. The stump is now cleaned, dried, and dusted with iodoform and is allowed to drop back through the incision into the lumen of the intussuscipiens. Then the longitudinal incision in the latter is closed by a continuous suture from end to end, and the operation is finished.

From a study of museum specimens and experiments made with artificially produced intussusceptions, I have thought that in cases of extensive invaginations a little variation in this method may be sometimes with advantage adopted. I have noted that the apex of the intussusceptum, greatly swollen as it is, when pulled upwards, by dragging on the entering bowel, simply crowds the plicated bowel up against the neck and so aggravates the constriction. To pull the receiving bowel down is to do the same thing; for counter-traction must equal traction. Now, if the swollen and indurated apex is removed, one great obstacle to reduction is removed. Also from the inside the pulling backward of the receiving bowel may be carried out piecemeal in the reverse manner in which it entered. Adhesions at the neck or elsewhere may be separated during the backward reduction. The steps of the modification may be gathered from the accompanying Figures (152, 153, 154).

In Fig. 152, drawn to scale from an actual specimen, the line A is at the neck, and the line B at the point selected for excision. The plicated intestinal folds between these lines represent a length of bowel much greater in actual specimens than is shown in the diagram; to cut all this away would greatly add to the risk of the operation and might seriously impair the patient's digestive powers on recovery. Although the apex of the intussusceptum bulks very largely in the whole

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tumour, it is really small as compared with the plicated bowel above it.   Half the actual tumour below may not be more than one-tenth or even one-twentieth of the actual length invaginated above.   I would, therefore, in cases of extensive intussusception, recommend removal of the apex of the intussus-ceptum and immediate suture of the bowels after Barker's plan ; then I should attempt reduction of the rest.

An incision is first made (between X and X, Fig. 152) through all the coats of the intussuscipiens along the free border, from the apex of the intus-susceptum, upwards for about three inches ; through this the intus-susceptum is delivered. A probe or rod pushed down the centre of it through the orifice, may help in the manipulation of the slippery mass and guide in the next step.   This is to transfix the tumour
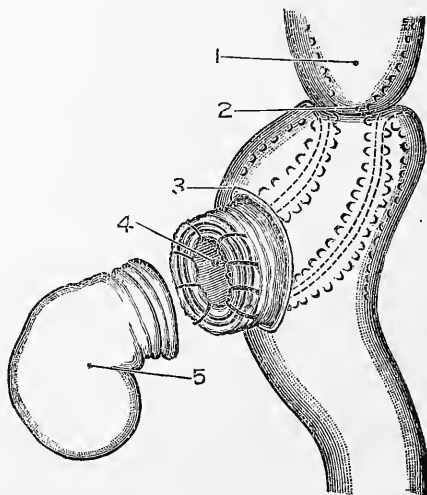
FIG. 153.

Diagram showing removal of Apex of Intussusceptum through incision in Intussuscipiens.

1. Entering bowel.
2. Neck of intussusceptum.
3. Incision in intussuscipiens.
4. Ends of divided bowels united by perforating sutures.
5. Apex of intussusceptum excised.

The mucous surfaces inside are shown as small festoons ; the serous as dotted lines.

crosswise with two large needles threaded with strong silk.   These maintain the parts in relation after excision and serve to place the first four sutures.   The apex is cut off with one stroke of scissors a little below the transfixing needles.   The four sutures so placed (this is Maunsell's method in reverse) are at once tied and four more are placed between them.   The sutured ends are permitted to slip inside and reduction is attempted.   The finger or a blunt instrument pushed up between the mucous

membranes will aid in the reduction, which should be done by pulling the receiving bowel downwards while adhesions at the neck are carefully detached. After reduction the sutured ends of the divided bowels may be several inches or even feet above the longitudinal incision. A protecting over-stitch is passed round the junction from the outside; the longitudinal incision is closed by a continuous Dupuytren suture, and the operation is finished.

Intussusception of the rectum may be treated locally without the performance of abdominal section. Barker* has resected an invaginated adenoid epithelioma of the rectum successfully, after stitching the divided walls of the gut together. Verneuil and Hulenkamp† had previously done the same operation.

Should reduction fail, resection of the superfluous bowel close to the neck and completion according to Barker's rules must be carried out.

Prof. Braun of Jena‡ has classified 63 cases of operation for invagination. For disinvagination the operation was performed 51 times: of these, 11 were cured and 40 died; 30 were children, 21 were adults. Of 10 cases in which enterectomy was performed, all died. After disinvagination failed, resection was performed 12 times without a single success; enterotomy 9 times, also without a success. Rosenthal§ has since then had a successful enterectomy for intussusception in a chronic case in a woman aged 35 years; and Braun and Brans are also each credited with a success. I have had one success after resection of a growth at the apex of the intussusceptum.

FIG. 154.

Operation of Resection of Intussusceptum completed. In the modification described the longitudinal incision would be lower down the bowel than is shown in the diagram.

* *Lancet*, May 14th, 1878.   † *Internat. Journ. Med. Sc.*, October, 1887, p. 529.
‡ *Archiv. f. Chir.*, Bd. xxxiii., Hft. 2.   § *Berl. Klin. Woch.*, Oct. 13th, 1890.

Curtis of New York* has collected and classified 70 cases of acute intussusception operated upon between 1873 and 1887 inclusive. He then found there were 105 recorded cases, with a total mortality of 70 per cent. In those cases where the intussusception was reduced the mortality was 58 per cent. Of those where the intussusception was not reduced nothing further was done in 7, and all died; resection and suture was done in 19, and 15 died; artificial anus with or without resection was left in 16 cases, 14 died.

A study of these figures shows that we have not yet got the right method of dealing with these cases. Neither Barker's method, nor the modification of it suggested, have had a fair trial; it is to be hoped the results will be better than those quoted.

One word of warning must be spoken in respect of methods of cure by rectal inflation. After apparent reduction recurrence is very liable to take place, and sudden death in children may result. I have had two such cases and have seen two more. A case reduced by inflation must be watched constantly, and the inflation repeated as often as signs of recurrence appear. In one of my fatal cases the appendix was intussuscepted into the cæcum, and this, after death, was found unreduced.

In Foreign Bodies.—It may be possible to pass these along when the abdomen is opened, so that opening of the gut may be unnecessary. It will, however, be wise in most cases to extract the body through an incision in the bowel. If the gut overlying the substance seems to be slightly inflamed, it may be opened immediately over it, and the material extracted with ease. If the bowel is inflamed, as will usually be the case, it will be wise to make the opening a little above the site of the obstruction, in the dilated and healthy intestine. The opening must be of sufficient dimensions to permit of the extraction of the foreign body without causing laceration. By preference the line of incision would lie in the long axis of the bowel, at its free margin. If the body cannot easily be pushed up to the opening, the opening may be pushed down to the body. It may be of advantage to crush or

* *N. Y. Med. Rec.*, 1891, vol. ii., p. 534.

compress the body before attempting to extract it. The intestinal contents may or may not, according as seems most convenient, be permitted to escape before removing the cause of obstruction. During the manipulations, scrupulous care will be observed to prevent the escape of fæces into the abdomen. If the bowel is seriously damaged by inflammation or ulceration, or looks gangrenous, the advisability of resection must be contemplated.

In *Tumours.*—The method of operation recommended in cases of obstruction caused by stricture induced by new growths has already been discussed under Enterectomy (p. 634) and need not here be reproduced. The simple steps in sequence may be restated as:

(1) Delivery of the tumour with the bowel, and fixation of it on the parietes by means of a rod passed through the mesentery.

(2) The making of an artificial anus above the growth in the dilated bowel.

(3) Resection of the tumour.

(4) Closure of the artificial anus left.

In *simple stricture* immediate entero-plasty is recommended (p. 594). A longitudinal incision is made in the bowel through the stricture and this is united transversely over a decalcified-bone tube.

In *unremovable growths* the best treatment is intestinal anastomosis joining healthy bowel above with healthy bowel below, so excluding the piece of bowel implicated in the growth (p. 641, Fig. 151).

In *general matting* by adhesions which cannot be separated the same operation of anastomosis is recommended, provided this does not necessitate the exclusion of too great a length of bowel.

Where *Gangrene* is found to have resulted from the obstruction, resection with enterorraphy, or resection with the formation of artificial anus, is to be done according to the indications of the case on the general lines laid down for enterectomy for gangrene (p. 591).

After-treatment. — The treatment of cases of operation for intestinal obstruction is almost as important as the operation itself. The behaviour of a case will vary according to the nature of the cause which has been removed, and according to the condition of the patient and of the intestines generally.

In every case of obstruction we must take it for granted that the stomach is not capable of disposing of sufficient nourishment or stimulant to support the patient. If food can be retained, so much the better; it will help; but we dare not depend on the stomach entirely. Therefore rectal alimentation should as a routine practice be begun at once and continued over one or two days, or longer if necessary. My favourite enema is one ounce of brandy, two teaspoonfuls of concentrated zyminised beef essence, and milk up to four ounces, administered every four hours. Alcohol is the sheet anchor, and it would seem as if its beneficent effects were more marked when administered by the rectum than by the mouth. Even before operation a few injections of brandy will sometimes put a new complexion on the case, lowering the pulse rate, improving its strength, ameliorating pain and encouraging sleep. Opium is to be avoided like the poison it is for these cases. It paralyses the bowels, the very thing we wish to avoid; it checks the secretions which we wish to increase; and it removes the signs of danger which we desire to be of the most prominent.

The case is closely watched from hour to hour : if it is clear that gas is passing downwards to the rectum, even in small quantities, we may be satisfied, for more will follow. But if no gas or fluid passes downwards, and if the distension does not diminish while sickness continues, we should re-open the abdomen by removing a stitch or two, and perform enterotomy. This re-opening should not be delayed too long; it is more easily done before the parietal incision has healed, and causes less pain to the patient. If the patient has had opium the symptoms will all have apparently improved, and danger warnings will have been obscured.

If rectal injections are well retained, we should be in no hurry to give food by the mouth. One copious vomit after operation,

encouraged by the patient's drinking several pints of any hot fluid which is liked, will often be of benefit. If the stomach-tube can be borne without causing much discomfort, it is even more effectual in emptying the stomach and upper bowels. After such an evacuation the patient will have a long rest, and will perhaps have refreshing sleep.

At the end of twenty-four hours or so food may be cautiously given by the mouth in small quantities; it should be either peptonised or of a nature which is easily absorbed and requires little digestion.

The patient should not be confined to one position, but should be moved from side to side and propped up for a few moments now and again. Everything is done that suggests itself to prevent intestinal stasis and gravitation of the fluid-laden bowels into the abdominal hollows. Occasional wearing of the rectal tube, a purgative enema, and gentle abdominal massage, are measures which are often of benefit. But no purgative ought ever to be given by the mouth until it is certain that all obstruction, in every sense of the word, has been removed.

After the third or fourth day the case is treated like other cases of abdominal operation.

Enterotomy—Enterostomy.

Conditions for which Operation performed.
Operation described.
> *Evacuation of Contents with Closure of Wound.*
> *Evacuation with Temporary Drainage.*
> *Operation for Permanent Drainage.*
> *Nélaton's Method.*

Enterotomy is the name usually given to the operation of making, after coeliotomy, an opening in the bowel through which its contents may be discharged. The name may properly be retained for incision and evacuation of the intestinal contents with immediate closure of the opening. When the opening is kept patent for days or even weeks, enterostomy is obviously the better term. The operation is usually performed on the small bowel; but it may fall to be done on the large bowel, and herein it overlaps colotomy or colostomy. It would be almost, but not quite, correct to say that enterotomy is a temporary opening intended to be closed, and that colotomy is a permanent opening ntended to last during the life of the patient. The exceptions to this statement would arise chiefly in cases of temporary colotomy.

The operation, as generally understood, was first performed on a patient of Trousseau's by Nélaton, and is often known as "Nélaton's operation." Nélaton introduced and advocated it as a plan of treating cases of intestinal obstruction which had lasted over six or eight days, in which there was great abdominal distension and where there was fæculent vomiting. In this sense it must be regarded as an undesirable but inevitable substitute for better and more radical proceedings. Many surgeons have performed the operation on Nélaton's principles, and the success, so far as immediate results were concerned, was on the whole gratifying. In recent years, however, the operation has taken an assured position, not as a substitute for curative proceedings but

as a supplement to them, and, being carried out in ways very different from Nélaton's, may be regarded as a new operation. It still has a value in the worst cases on the same principles as were laid down by Nélaton, but in every such case it is distinctly regarded as a temporary proceeding.

CONDITIONS FOR WHICH THE OPERATION MAY BE PERFORMED.

The call to perform the operation is practically always some form of intestinal obstruction. The method of operating follows the nature of the case and the sort of relief which is sought to be obtained. The indications and the modes of relief may be classified as follows :—

I. In desperate cases where there is imminent risk of death from great abdominal distension, vomiting, and toxin poisoning, a blind enterotomy may be done without general anæsthesia. The first coil of dilated bowel is brought to the surface and is incised and drained, and no regard is paid to the removal of the cause of obstruction.

II. In cases of operation after the cause of obstruction has been removed where there is excessive local but not general distension, evacuation of intestinal contents may be carried out through an incision in the bowel, which is immediately sutured and returned.

III. In cases of operation where the cause has been removed but may recur (as in volvulus), or where there is great and general distension, drainage of liquid or gaseous intestinal contents is provided for so as to continue over one or more days. In this case a tube is fixed in the bowel, and provision is made for its subsequent removal with closure of the wound.

IV. Where the cause cannot be removed or cannot be found, arrangement is made for drainage to be continued indefinitely. In this case also a tube is placed in the bowel, but no special provision is taken with a view to subsequent closure.

In describing the methods of operating, the methods for the first and the fourth indications are the same. This leaves three methods of operating: (1) simple evacuation, (2) temporary drainage, (3) permanent enterostomy.

ENTEROTOMY FOR EVACUATION WITH IMMEDIATE CLOSURE
OF THE INCISION.

This is a very simple proceeding. The actual relief of the obstruction so far as removal of the exciting cause is concerned has been concluded ; the parietal sutures are placed but not tied, their ends being caught in two pairs of forceps placed on the abdomen. The evacuation of the intestinal contents is carried out while the patient is recovering from the anæsthetic, and is continued for as long as may be necessary after the patient has completely recovered consciousness. An intelligent patient may have the process explained to him ; he will bear it all the more readily also that, with every discharge, he feels the distension decreasing, and enjoys once again the delight of being able to inhale a chestful of air.

The distended intestinal coil is delivered through the parietal wound and thoroughly isolated by sponges and sponge-cloths up to the most prominent part ; this is left exposed. The loop is held in position by grasping the mesentery between the finger and thumb ; the bowel itself is not touched. A simple incision about an inch in length is made at the free border of the gut left exposed for the purpose. Around the incision antiseptic paste may be spread, but this is not necessary. It is better to employ a simple incision than evacuation through trocar and tubing, for the reasons that evacuation through the large incision is more rapid, that escape of gas and fluids by the side of the trocar puncture is certain to take place, and that the unavoidable movements of the bowel render fixation of the trocar in position rather difficult and troublesome. The left hand holding the mesentery between fingers and thumb keeps the bowel well in position, and the palm maintains apposition between the cloths and its surface.

There is at first a free escape of gas with perhaps a little fluid. This is collected in a dish held under the opening. In a few moments there may be a second and a third discharge, then possibly a long rest. The bowels have been emptied up to the first few flexures, but the mass of coils are still distended.

Slowly they empty themselves into the now emptied coils, but intra-abdominal pressure being removed and the bowels now showing a disposition to remain inert, the evacuation may be assisted by pressure over the abdominal surface. Gentle systematic kneading is now carried out over the whole abdominal surface, and will be found materially to accelerate the process of evacuation.

When the abdomen has returned to its natural dimensions or nearly so, the wound in the bowel is sutured by a double Dupuytren suture, the intestinal walls are thoroughly cleansed, the intestine is returned into the cavity and the sutures already placed in the parietal wound are tied. The operation is then concluded.

I have occasionally left a thread attached to the intestine in the wound, so that in case of recurrence of distension the bowel may be readily drawn to the surface again for re-opening. But this, I think, does more harm than good by anchoring the bowel, while the re-opening is easy enough without this assistance.

After evacuation the distension recurs to some extent, and must be closely watched. Usually it soon abates with the passage of gas per rectum, and later on it disappears when the bowels act.

ENTEROTOMY FOR DRAINAGE WITH TEMPORARY WEARING OF TUBE AND SUBSEQUENT CLOSURE.

In cases of extreme distension, or where there is great weakness of the patient, or where it is desirable (as in volvulus) to fix the bowel, drainage for a day or two is the method recommended.

In the method of drainage employed one element of supreme importance is simplicity. It ought to be capable of being rapidly applied by the surgeon, and of being easily managed by the nurse or attendant. For the drainage tube, at first I used india-rubber; then I tried celluloid tubing; and this, moulded in hot water into various shapes and curves, I employed for several years. I have

also tried Paul's glass tubes. But I have finally abandoned all hard and unyielding material, and have returned to the use of the simple pliable rubber tube. Tubes of hard texture which do not yield to the constantly moving intestine set up irritation, and cause a secretion of mucus which necessitates dressing and is not easily collected in any dressing fabric. Ligation of the gut around the tubing, as in Paul's method, causes sloughing of a ring of bowel; this, in my opinion, is a grave defect in the method. Perfectly satisfactory drainage, and fixation of tube and bowel, can be carried out by rubber tubing and without the employment of any encircling ligature, or indeed of any suture at all.

The rubber tubing has incidental advantages. If it becomes blocked it can easily be cleared by pinching; "milking" its contents onwards. It permits movements of the patient without any addition to the risk. It can be introduced on the stretch, of a smaller calibre than the opening in the bowel, and, when released, it distends and accurately fits the intestinal opening. It can be fixed in the bowel with great ease;

FIG. 155.

Diagram to show Method of Temporary Enterostomy.

B, Bowel. M, Mesentery. T, Rubber tube. P, Peritoneum. 1, Strapping fixing dressing. 2, Pin holding bowel and tubing in position. X——X, Enlarged view of plan of fixing bowel and tube by pin and suture.

a safety-pin transfixing bowel and picking up the side of the tubing is quite efficient. The method shown in the diagram (Fig. 155) partially provides for subsequent closure of the opening

by simply pulling on the thread; the transfixing needle holds the parts in position.

The tubing in every case should have thick walls; it must be capable of being bent beyond a right angle without kinking. Its calibre varies according to the nature of the material it has to drain. For gas a tube of very small calibre will suffice; for fluids a tube as large as a crow-quill will be necessary. In these cases the intestinal fluids are poisons, and the sooner they are removed the better for the patient. For drainage of the large bowel a tube as large as the finger should be used, because rapid evacuation is even of more importance, while the amount of material is likely to be greater. Also, after the first few hours, the fæces may become pultaceous, and so be difficult of removal.

In detail the steps of the proceeding are as follows: Between the second and third fingers of the assistant's left hand, and the same fingers of his right hand, held back to back, a **V**-shaped piece of the intestinal border is compressed and excluded. On the free border of this fold the incision is made large enough to admit the tubing. If the bowel is properly held no gas or fluid escapes. With fine peritoneal catch-forceps the mucous membrane on each side of the small incision is grasped and pulled out a little way, and the tubing, stretched over a blunt probe, is pushed through the opening. The tubing is at once fixed to the margin of the incision by a safety-pin or two, or in the manner shown in the diagram. If it fits accurately there will be no escape of intestinal contents by its side. The fingers of the assistant are now removed, and the gases and fluids permitted to escape. When the bowel has collapsed the loop is cleansed and returned into the abdomen, leaving outside about an inch of bowel containing the tubing. The tubing should at its inner extremity clear the parietes, but need go no further inside. The parietal sutures, already placed, are now tied, all save one which is to be tied in a few days when the extruded loop is returned.

I am doubtful about the wisdom of bringing up the peritoneum as shown in the diagram. It makes the return of the bowel easier perhaps, but it imports the danger of having the

cavity close to the wound in the intestine. It certainly is not necessary.

The dressings are now applied. Firstly, gutta-percha tissue is wrapped round the gut to prevent adhesion to the dressings. The parts are carefully cleansed, and dusted with boric powder and iodoform. Then strips of boric lint are lightly wound round the bowel and tube, so as to keep them in contact and support both by holding up the transfixing pin (Fig. 155). The lint thus piled up prevents protrusion of bowel as well as in-drawing. The whole is now fixed immovably in position by a broad belt of

FIG. 156.

Diagram to show an Arrangement for Intestinal Drainage.

strapping, which passes round the back and inter-digitates in front around the tubing (Fig. 156). Finally, the free end of the tubing is placed in a receptacle of some sort by the side of the patient. A rubber bag containing absorbent and antiseptic wool serves the purpose very well. A bottle is most easily emptied and kept clean.

ENTEROTOMY WITH PERMANENT DRAINAGE.   ENTEROSTOMY.
COLOSTOMY.

In cases where the cause of the obstruction cannot be removed, permanent drainage on the formation of an artificial anus is indicated. This in the large bowel is essentially colostomy or colotomy, and will be fully described under that head. But in some cases of temporary drainage the same method may well be employed.

These cases would be where there is a large collection of fæces in the colon which it is important quickly to remove, or where the fæces are not quite liquid. Such cases would include also those in which enterectomy was intended to be done in stages. The tumour, pulled outside, would be in the position occupied by the figures 1, 2, 3 in Fig. 157.

In this case the bowel is fixed outside by a stiff rod passing through the mesentery and resting on the parietes. The tube is a large one with thick walls, and to facilitate the passing of fæces its interior is coated with vaseline by pulling a pledget of lint through it soaked with the material. It is fixed to the bowel at the margins of the incision by a couple of safety-pins piercing bowel and rubber. The method will be understood by

Fɪɢ. 157.

Diagram to Show Method of Draining Large Bowel.

B, Bowel on proximal side of Spur. B/, Bowel collapsed below Spur. T, Rubber Tubing. Sp., Spur; at the top the black circular spot represents a section of the supporting rod. 1, Strapping. 2, Gutta-percha Tissue. 3, Absorbent Dressing.

a reference to the accompanying Figure, and to the full description given under Colotomy.

The foregoing description relates only to the operation of enterotomy as performed by the writer. As introduced by Nélaton, and as usually performed to-day, the operation involves

suture of the intestinal wall to the skin of the parietes. With this is often associated bringing up of the parietal peritoneum to the cutaneous margin, and suturing bowel, peritoneum, and skin together. The operation is sometimes done in two stages, and then fixation may be carried out by two hare-lip pins passed through the serosa, musculature and submucosa, and resting on the parietes.

For reasons which have already been dwelt upon in this work and need not be repeated, I consider it both unwise and unnecessary to bring up the parietal peritoneum to the skin. To employ sutures between bowel and parietes is also unnecessary for holding the bowel; it does not so easily or safely permit of immediate drainage as the method described, where a tube of bowel surrounds the drainage tube and is held in position more firmly than by stitches; the insertion of the stitches occupies time; and if the opening is to be closed later on, a long line of sutured bowel is not so easily detached as a small directly entering tube. For these reasons I venture to recommend the methods described above as superior to the old methods of Nélaton.

After-treatment.—No special description of the after-treatment is necessary. Rectal feeding will usually be carried out for a few days. Locally, the junction of bowel and tube is watched for leakage, and a fresh roll of lint is wound round bowel and tube should leakage occur. Case after case, drained from the beginning, shows no leakage, and little trouble need be apprehended from this source. Should it occur, it is absorbed by the lint far away from the cavity and does no harm. The permeability of the tube is frequently ascertained; any blocking is easily overcome by pinching, or by passing a flexible rod down it into the cavity of the bowel. At the end of the first day the dressings may be changed; thereafter all risk of peritoneal contamination is practically over.

Colotomy—Colostomy.

History.
Conditions Indicating Operation.
    As a Curative Measure.
        In Ulceration of Colon.
        In Atony of Colon.
        In Volvulus of Sigmoid.
        In Recto-vesical Fistula.
    To ward off imminent Death.
        In Obstruction of the Colon.
        In Imperforate Anus.
    As an Ameliorative Measure.
        In Incurable Malignant Disease.
Mortality. Appreciation. Choice of Method.
Operation described.
    Lumbar Colotomy.
        Anatomical Considerations.
        Parietal Incision.
        Finding, Fixing, and Opening the Bowel.
        Management of Anus. After-treatment.
    Cælio-colotomy.
        Anatomical Considerations.
        Operative Methods.
            Method of Verneuil.
                ,,   *Ball.*
                ,,   *Allingham.*
                ,,   *Harrison Cripps.*
                ,,   *Maydl-Reclus.*
              Parietal Incision.
              Finding and Fixing Bowel.
              Opening of Bowel.
              After-treatment.

The term Colotomy is used to name the operation whereby an opening is made in the colon at any part of its course through which the fæces are permitted to escape. Colostomy would be the name most in harmony with modern nomenclature; but colotomy has been for so long employed with the significance of colostomy that its true meaning can scarcely be mistaken.

History.—Colotomy was first proposed by Littré, in 1710.[*] His proceeding was, to open the sigmoid flexure of the colon by incision through the abdominal walls in the left inguinal region. It was suggested for imperforate anus in children. It is not probable that Littré ever actually performed the operation; and his suggestion was forgotten till 1776, when Pilloré of Rouen operated, but by a different method. He opened the cæcum by a parietal incision made in the right inguinal region. Twenty years later Callisen suggested an operation whereby the colon might be opened without entering the peritoneal cavity. He sought to expose the bowel where it was not covered by peritoneum by a vertical incision in the left lumbar region. He failed to do this on the dead subject, and he never attempted it on the living. Fine of Geneva, in 1797, made an opening in the transverse colon through an incision in the region of the umbilicus. Amussat, driven to think of it while he was attending the famous Broussais for cancer of the rectum, actually performed the retro-peritoneal operation. He operated on the right side by a transverse incision. In the two following years he operated six times, with five successes. In 1842 Ashmead of Philadelphia,[†] not aware of Callisen's proposal, performed a retro-peritoneal lumbar colotomy by a vertical incision on the left side.

The lumbar operation, as usually performed now, is a combination of the methods of Callisen and Amussat. Like Callisen's, it is done on the left side; and like Amussat's, it is carried out through an incision which is either transverse or obliquely transverse. The oblique incision, first recommended by Bryant,[‡] is that now adopted by most surgeons.

* *Mem. Acad. Sc. Paris*, vol. x., p. 36.
† *Trans. Coll. Phys. Phila.*, vol. i., p. 99, 1842.
‡ *Trans. Med.-Chir. Soc.*, vol. xxxv., p. 99.

The tendency is now, however, to return to the original method of Littré, and perform the operation in the left inguinal region after entering the peritoneal cavity. The lumbar or retro-peritoneal operation is not abandoned, but it is done much less frequently than it used to be, while the inguinal or trans-peritoneal operation is coming more and more into favour.

CONDITIONS INDICATING OPERATION.

Colotomy may be performed for any condition which obstructs the passage of fæces along the colon, or under any circumstances in which it is advisable to place that bowel at rest. Obstruction may be produced by various causes ; such as, cancer of the rectum or sigmoid flexure or any other part of the colon ; tumours of the peritoneum or any abdominal organ, pressing on the bowel; volvulus of the sigmoid flexure or of the cæcum and ascending colon ; and fæcal accumulations and collections of foreign matter which cannot be disturbed by other means. It may be called for in cases of incurable ulceration of the bowel, however induced, when we have reason to believe that irritation of fæces and unrest of the intestinal walls con-tribute to the continuance of the disease ; and in cases of extreme dilatation, with atony of the colon, giving rise to frequent attacks of obstruction.

The operation may be considered from three points of view : (1) as a curative measure, (2) as a measure intended to ward off for a time impending death, (3) as a proceeding intended, in the absence of immediate danger to life, to add to the comfort of the patient and prolong his existence.

As a *curative measure*, colotomy may be performed in cases of ulceration of the rectum, simple or specific, when all other measures have failed ; in excessive distension, with atony of the colon ; in volvulus of the sigmoid flexure, and in recto-vesical fistula.

In ulceration of the rectum, the condition may be kept up or aggravated by the irritation of passing fæces and by the

spasmodic contractions of the hyperæsthetic bowel. By making an artificial anus above the ulcerated part, the bowel is set at rest, and the fæces do not come into contact with the ulcerated mucous membrane. In most cases it will be sufficient to operate on the left side; but if we suspect that the ulceration extends higher up than the sigmoid flexure, it will be better to operate on the right side.

In cases of excessive distension of the colon with atony of its walls, where, in spite of strong purgation and the administration of enemas, fæces accumulate and symptoms of obstruction frequently appear, right colotomy is indicated. By giving an exit to the fæces at the commencement of the colon, the bowel is kept empty, and has an opportunity of contracting and regaining its tone. From being a flaccid tube with no power of spontaneous contraction and an almost unlimited capacity for distension, it will, in the course of a few weeks' rest and freedom from distension, regain its functions as a contractile viscus of limited calibre.

For volvulus of the sigmoid flexure, Bryant recommends lumbar colotomy as a remedial measure. There is much to be said in favour of the proceeding for this condition. As compared with coeliotomy, it is not theoretically so perfect; but we have already seen that coeliotomy in volvulus is not likely to be practically successful in every sense, and that it will possibly result in the formation of artificial anus. Whatever advantages accrue from the retro-peritoneal operation are most marked here: these are, probably less severity in the operation itself; avoidance of the risk of escape of fæces into the abdomen, which, with the enormous collections that are usually found in these cases, must be considerable; and greater facility in operating. But each case must be decided on its merits.

In cases of recto-vesical fistula which have lasted for some time, colotomy gives the only chance of cure short of resection. The fæces passing through the opening in the colon, no longer traverse the fistula, the rectum collapses, and the fistula spontaneously closes. The presence of severe cystitis, the frequency

with which attacks of retention of urine appear, the condition of the patient, and various other circumstances, will in each case promote or restrain the advisability of operation.

As a measure *intended to ward off imminent death*, colotomy may be called for in cases of obstruction in the colon, from whatever cause arising. The great majority of such cases are examples of cancer of the rectum. The condition of the patient must in every case settle the justifiability of the operation. If the patient is evidently so near death from the disease that relief of the obstruction can prolong life only for a week or two at most, it will be wise to let nature have its way. The choice between a death from obstruction, and a death from exhaustion interrupted by the terrors of a serious operation, is a choice of evils nearly equal. But if the obstruction comes on in the earlier stages of the disease, when the patient is not greatly weakened, and when a successful result to the operation means not only escape of death from obstruction but prolongation of life, with increase of comfort, then the operation is clearly indicated.

The indications in other forms of obstruction from growths which are not removable—either in the gut itself, or invading or pressing upon it from the outside—are similar to those for cancer of the rectum.

It has been said that an operation which is not intended to cure the disease, and which places the patient in a condition which " must inevitably render him an object of disgust to himself and of loathing to everyone around," ought never to be performed. The inevitable result of the operation need not be revolting ; properly managed, it need cause little more than discomfort. And even if the result were revolting, and the patients' sufferings were such that they would wish to die, it is still our duty, according to the highest ethics, to do all that we can to encourage them and to help them to live.

As an *Ameliorative Proceeding in cases of Malignant Disease* where there are no symptoms of obstruction, and where it is

intended to give relief to the patient from the irritation produced by the passage of fæces over the growth, and to remove from the growth itself this source of harm, colotomy is more open to discussion. The progress of cases for which the operation, under these conditions, has been performed is notoriously uncertain. I have operated on a case in which there were no signs of obstruction, and in whom a likelihood of prolonged life, with increased comfort, was predicted : the patient died suddenly, of hæmorrhage from the growth. In another, a sister of the previous patient, weaker constitutionally, and with a much larger growth, life was prolonged for more than a year, and the patient died of extension of the growth to the peritoneum. Cases, again, are recorded where decided improvement sets in, and continues for some time, where no operation has been performed.

Statistics give us no help in forming an estimate of the duration of life in such cases, with and without operation. I think it is doubtful if surgeons as a rule follow the outspoken advice of Bryant, to operate as soon as malignant disease is discovered ; and much might be said in support of their practice —at all events, it cannot unreservedly be condemned. The patient ought to have an opportunity of deciding : in my experience, the decision is usually against operation.

For *Imperforate Anus* the operation holds a special position. It is intended to ward off death, but it may or may not be regarded as a cure for the disease. In many cases, it is the first step in the process of cure. In every infant born with imperforate anus, an operation of a local nature is first attempted ; if this fails, colotomy by some method is performed, to ward off death : later on, an attempt may be made to get the bowel to discharge through the anus.

Mortality. Appreciation. Choice of Method.—The most complete and elaborate statistics on colotomy which have as yet been published are those collected by Dr. W. R. Batt.* He

* *Amer. Journ. of Med. Sc.,* Oct., 1884.

records 351 operations; of these, 215 (62 per cent.) recovered, and 132 (38 per cent.) died,—4 having unknown result. The mortality after the various methods was:

	Operations.	Recovered.	Died.	Unknown.
After Amussat's method	244	165 (68°/₀)	77 (31.6°/₀)	2
„ Littré's „	82	38 (47°/₀)	43 (53.1°/₀)	1
„ Callisen's „	10	2	7	1
In Linea Alba	4	4	—	—

These results tally in a remarkable manner with those found in another notable collection by Van Erckelens.* He brought forward 262 cases of colotomy, with 151 recoveries and 109 deaths.

	Operations.	Recovered.	Died.
Amussat's method ...	165	102 (62°/₀)	63 (38°/₀)
Littré's „ ...	84	45 (53°/c)	39 (46.4°/₀)

If these statistics can be taken as trustworthy, they would seem to indicate an improvement in the mortality of something like ten per cent. in the five years preceding 1884.

Many facts of interest and importance which cannot be referred to here are worked out in Dr. Batt's paper. The mortality after all operations for malignant disease was found to be a little over 30 per cent. Amussat's method gave a mortality of just over 25 per cent.; Littré's gave 45 per cent. If it were proper to reason from the results of these old operations, there is therefore a 20 per cent. probability of success in favour of retro-peritoneal colotomy : the mortality would now be the other way. Of 52 operations for imperforate anus, more than half died ; and the chance of recovery is about equally balanced between the two methods. Of 20 operations for fistula, all recovered save two. Of 40 operations for obstruction, one-half died ; the best results being got from Amussat's operation. Of 72 for stricture, 43 per cent. died, also with better results by Amussat's method.

Of those cases which recovered from operations for malignant

* Langenbeck's *Archiv.*, 1879, p. 41.

disease, 12 died within 6 months, 15 died between the 6th and
12th month; 10 died between the 1st and 2nd year; 8 died
between the 2nd and 3rd year, and 1 died at the end of
4½ years.

In respect to Cœlio-colotomy, as the modern development
of Littré's method may be named, there are not yet very full
statistics. Allingham* can speak of 50 operations with two
deaths; Harrison Cripps has had a very low mortality; I
have had, in 48 operations, three deaths—two after complete
obstruction, and one after ten days where the patient was
almost too exhausted for operation of any sort. Other reports
of modern operations give a general mortality of about 10
per cent. for cœlio-colotomy. For lumbo-colotomy done in the
last five years it is impossible to give statistics; I think they
would be less favourable.

It will thus be seen that, under every circumstance, favour-
able or otherwise, colotomy is not a very deadly operation.
Mere statistics cannot, however, give a just estimate of the
mortality. Many operations are performed when the patient
is *in extremis;* and in these the result is tabulated as failure,
even if the patient lives for ten days or a fortnight in com-
parative comfort. To class such cases with others in which
the operation is performed while the patient is in fair condition
adds to the mortality of the operation unjustly. The conditions
under which the operation is performed are so varied, and
even divergent, that the comparison of figures is of little
value, except as affording means of comparison between
different operations.

For imperforate anus, Littré's method, of dividing the
parietes in the left inguinal region and entering the peritoneum,
is certainly the best. With imperforate anus are frequently
found other malformations of the colon which would render
colotomy impossible by the retro-peritoneal method. Indeed,
to render the chances of success in completing colotomy most
certain, it is doubtful whether the median incision would not be
best of all. The distended bowel can be brought to the middle

* *Brit. Med. Journ.*, 1891, II., p. 949.

line either from the right or the left side : if the descending
colon exists, it may be opened ; if it does not exist, the as-
cending colon may be opened ; and if, as sometimes happens,
the distended rectum is median in position, the advantages of the
median incision will be most conspicuous. Frequently the situation
of the bowel may be located by percussion and palpation.

As the names given to the operation, following the proper
names of individual surgeons, have already lost their signifi-
cance and have caused a good deal of confusion, it will be
convenient to speak of the retro-peritoneal method as Lumbar
Colotomy ; and of the methods in which the abdominal cavity is
entered, as Cœlio-colotomy.

THE OPERATION OF LUMBAR COLOTOMY.

Anatomical Considerations.—By Lumbar Colotomy is meant the
making of an opening in the colon, ascending or descending, on
either side of the body, within that area where it is not covered
by peritoneum, and where it is attached to the abdominal walls by
cellular tissue. The opening is made through an incision in the
lumbar region—that is, in the space bounded by the last rib
above, and the crest of the ilium below, and lying within lines
drawn vertically between the middle of the iliac crest and the
last ribs in front, and the lumbar group of muscles behind.
Dividing the space vertically is the edge of the quadratus
lumborum and the fascia transversalis. At the bottom of the
space lies the colon, in its upper part overlapping the kidney ;
in its lower part lying in contact with the abdominal wall, and
attached to it by cellular tissue. (See Fig. 158, 8 & 18.) The
area of contact varies in extent with the amount of distension of
the bowel. In full distension the bowel glides under the peri-
toneum, displacing it laterally, so that the surface in contact
with the parietes is broadened. When the bowel is contracted,
the peritoneum enfolds it more or less completely according to
the length of the mesentery. It is always possible to separate
the collapsing peritoneal folds, even when the bowel is empty,

and so to reach the bowel without entering the peritoneal cavity. It must be noted that, according to Treves's investigations, there is more likelihood of a mesentery being found on the left than on the right side.

The best practical guide to the site of the bowel is that furnished by Allingham, as a result of numerous dissections. It will be found directly under a point marked on the skin about half an inch behind the middle of the crest of the ilium, as measured between its anterior and posterior spines. It has been recommended that this point be marked on the skin in ink. But, as a matter of fact, when the muscles have been divided, the forefinger is the best guide.

Parietal Incision.—The oblique incision recommended by Bryant
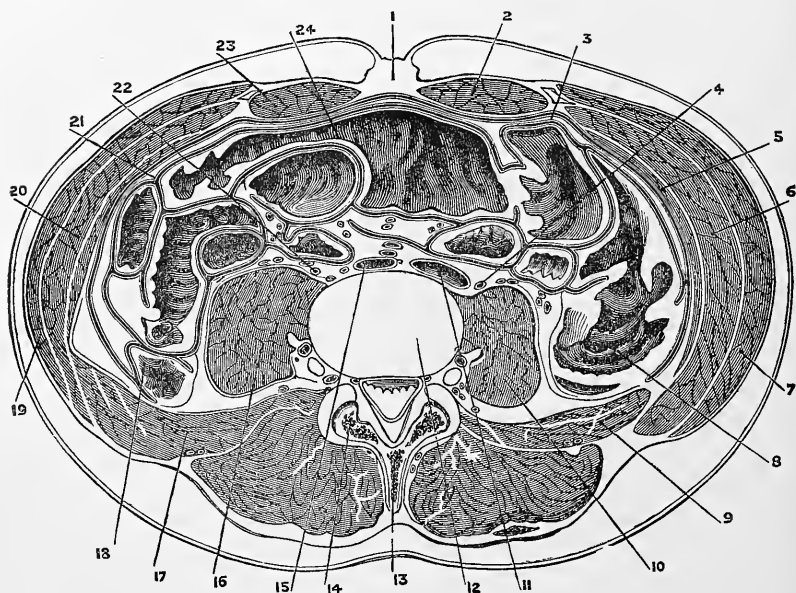
FIG. 158. (*After* BRAUNE.)

Transverse Section through the Navel to show the parts concerned in Colotomy.

1. Umbilicus. 2. Rectus Muscle. 3. Great Omentum. 4. Ureter. 5. Transversalis Muscle. 6. Internal Oblique. 7. Right External Oblique. 8. Ascending Colon. 9. Quadratus Lumborum. 10. Psoas Muscle. 11. Inferior Vena Cava. 12. Cartilage between 3rd and 4th Lumbar Vertebræ. 13. Spinous Process of 4th Lumbar Vertebra. 14. Lamina of 3rd Lumbar Vertebra. 15. Descending Aorta. 16. Psoas. 17. Quadratus Lumborum. 18. Descending Colon. 19. External Oblique. 20. Internal Oblique. 21. Omentum. 22. Ureter. 23. Rectus. 24. Transverse Colon

is the best. Its chief advantage is, that it gives more room for its length than do other incisions. Further claims in its favour are, that it necessitates division of a smaller number of nerves and vessels than other methods ; and that it facilitates coaptation by lying in the line of a natural fold, and helps to prevent prolapse of the bowel by lying almost transversely to its axis. In thin patients, and particularly in women, whose iliac crests are more prominent than in men, there is a tendency for the upper lip of the wound to fall inwards, while the lower lip protrudes. This may be obviated by careful apposition, and by not bringing the line of the incision too close to the ilium.

The patient is laid on her side, or almost semiprone, and a hard round pillow is placed under the opposite loin, to separate the last rib from the ilium as much as possible, and make the site of operation prominent. The centre is at the point indicated —a little behind the centre of the crest of the ilium. Its length will vary according as the patient is fat or thin. Four or five inches is the length usually recommended ; but this is the extreme. In a thin patient two inches is ample ; and I have found, in a very fat woman, three inches to give plenty of room. It will be found most convenient to have the bulk of the incision behind the point marked as the site of the bowel. The incision starts about an inch in front of and above this point, and passes obliquely upwards and backwards towards the angle formed by the spine and the last rib, for a distance varying according to the nature of the case. The various structures are divided by successive strokes of the knife or scissors, forceps being placed on the bleeding-points. The parts divided after the skin and superficial fascia are : some fibres of the latissimus dorsi, the posterior fibres of the external oblique, the internal oblique, and the lumbar fascia. The anterior edge of the quadratus lumborum will then appear in the wound, and may be divided or not, as seems convenient. The fibres of the transversalis may often be separated without division. When the transversalis fascia has been divided, the fat which underlies the colon will bulge into the wound. Each of these layers is divided to the whole extent of the cutaneous incision.

The sub-peritoneal adipose tissue is usually abundant, even in lean subjects. It is frequently found in well-defined strata, separated by layers of fascia. I have more than once seen these layers mistaken for bowel, and treated accordingly. Indeed, when in doubt as to a fascial fold being bowel or not, it is always best to treat it as if it were. An error is then harmless. The fat is teased aside by the fingers, a cutting instrument being used as sparingly as possible. If it is very abundant it may be removed, to give additional space.

Finding, Fixing and Opening the Bowel.—Various means of recognising the bowel have been described, such as its immobility, and the presence of bands on its surface. These would be valuable if the peritoneum were opened. In feeling for the bowel, the forefinger and thumb, or the first two fingers, are inserted into the wound, separating its margins. The bowel, if distended, will bulge outwards, and may be readily seized. If it is empty, it is sought for more deeply in the wound, keeping well backwards and separating the overlying tissues widely. If the peritoneum is pushed apart by the two fingers, only colon can be grasped between its layers. The existence of hard fæces inside the bowel is an infallible guide. The surgeon ought, from practice on the dead body, to be familiar with the sensation that colon gives when pinched up between the fingers through a lumbar incision; and this sensation is more trustworthy than any other guide, or any combination of guides.

In a very few cases[*] no colon has been found, on account of the existence of congenital abnormality. In others, the small intestine has been opened by mistake for the colon. We have it on the authority of Ball[†] of Dublin that one of the most experienced of living colotomists has candidly admitted that he opened the duodenum on the right side, believing it to be the colon.

If, during the manipulations, the peritoneum has been torn through, it must be closed at once. This may be done by catching the edges of the laceration in forceps, pulling it into the

[*] See Lockwood, *St. Bart.'s Hosp. Rep.*, vol. xix.
[†] *The Rectum and Anus*, Lond., 1887, p. 357.

wound, and surrounding it with a ligature. This produces perfect closure, with apposition of serous surfaces. I have, on one occasion, seen this done, and no harm result. If the rent in the peritoneum is large, the bowels may prolapse into the wound. After reducing the bowels, advantage may be taken of the presence of the fingers in the cavity to search for the colon and make it bulge into the wound. A forceps may then be placed on its wall as a guide, and the rent in the peritoneum closed. Thereafter the operation is proceeded with as if nothing had happened.

If the bowel is distended with fæces, the ends and deep parts of the parietal wound should be closed before opening it.

FIG. 159.

Lund's Insufflator.

A. Hollow Rubber Ring which is pressed against the Tissues around the Anus ; *a* Rectum Tube ; **C.** Longer Rectum Tube ; **B.** Ball-syringe attached to Instrument.

There is always some risk of burrowing suppuration ; and accurate apposition of deep as well as superficial parts ought to be secured. The best way to do this is by continuous buried sutures of catgut carried from the deep parts of the wound to its surface ; but deep silver button-sutures answer fairly well. A drainage-tube is placed deeply at the end of each half of the wound. To provide against the contact of fæces, the wound must be protected by lint soaked in some antiseptic material, of which there is nothing better than boro-glyceride.

If there is much difficulty in seizing an undilated colon, a Lund's insufflator (Fig. 159) may be used, to cause its distension by air or fluid. Some surgeons recommend that the operation be begun by artificially distending the colon. If there is complete obstruction in the rectum, this is, of course, impossible ; and, in

any case, it need not be done till the necessity for it has become apparent.

The bowel may at once be opened and fixed to the edges of the wound; or, if there is no urgency, it may be fixed, and the opening delayed for a few days till the wound has united and the bowel has become adherent in its new situation. Delay in opening the bowel greatly diminishes the risk of unhealthy action in the wound, and permits the employment of antiseptic treatment. On the other hand, if there is obstruction, the bowel must be opened at once, and the wound protected as well as possible by boracic ointment, or carbolised oil, or boro-glyceride. The experience of Davies-Colley in the operation *à deux temps* has shown that symptoms of intestinal strangulation may be induced by the retention of a loop of bowel in the wound. To obviate this objection he has devised a clamp which holds the bowel between ivory studs, while it does not strangulate it.

To fix the bowel in the wound, if opening is to be delayed, Howse's plan of fixation by forceps is the best. Two pairs of catch-forceps are made to grasp small folds of the muscular coats of the colon with just sufficient force to hold and not to cause sloughing. They are placed about half an inch apart, and at right angles to the line of incision. The forceps are laid flat on the skin, and kept in position by broad strips of plaster. At the end of a week, or less, the bowel may be incised between the points where the forceps are attached. Sutures placed in the bowel are liable to produce small fistulæ, through which the fæces escape.

If the bowel is to be opened at once, it must be fixed to the edges of the wound by sutures. For catching the bowel and drawing it out of the wound, Lund * has invented handled needles with points set at right angles to the shaft, and sharply curved (Fig. 160). Ordinary curved needles do very well. Two pieces of thick silk, with needles at each end, are inserted in the bowel at the four corners of an area about an inch square.

* *Lancet*, vol. i., 1883.

While these stitches, grasped in the two hands of an assistant, are made to pull the bowel outwards, the surgeon makes a small opening with a tenotomy knife. A blunt hook passed through the opening pulls out the threads inside the bowel, which are cut in the middle, and thus make four points of support. Each suture is then carried through the skin at the margins of the wound by the needle attached, and there tied. Around the opening in the bowel there will thus be placed four sutures — two on each lip of the wound. Additional security will be afforded by placing two more stitches, each passing through the edges of the parietal incision, and hooking up the corner of the opening in the bowel. I prefer silk to silver as sutures, simply because, in the subsequent frequent cleansing of the wound, the ends of the silver sutures will catch in the wool or sponge and so far interfere with the manipulation.
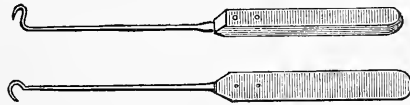
FIG. 160.

Lund's Hooks for picking up the Bowel in Colotomy.

Management of Anus.—In most cases there is an immediate discharge of fæces through the wound ; but sometimes this discharge does not take place for hours, or even for days. If the fæculent matter is hard or in lumps, its escape may be impossible, or it may cause considerable pain. In this event, Lund's forceps* (Fig. 161) will be found useful.

FIG. 161.

Lund's Forceps for removing Hardened Fæces in Colotomy.

If the discharge is frequent and abundant, very frequent dressings of the wound will be necessary. Large pads of absorbent antiseptic and deodorising material, kept in position by a square of mackintosh cloth, to each corner of which a piece of strapping has

* *Lancet,* vol. i., 1886.

been fixed by a safety-pin, is a convenient form of dressing.
Bandages carried round the body are clumsy and inefficient as a
means of fixing the dressing. The piece of adhesive plaster at
each corner of the square of mackintosh will be found efficient
enough in most cases; if not, extra pieces may be pinned on
along the borders.

The position of the patient is not a matter of great import-
ance. Comfort will be increased by changing the position
slightly at each dressing.

Primary healing may be anticipated with considerable con-
fidence in every case, provided the wound is properly attended
to. The disadvantages of suppuration in a wound constantly
brought into contact with fæculent fluids and gases are evident
enough.

When the wound is perfectly healed, and the artificial anus
is established, an apparatus of some form or other must be worn,
to collect any fæces that may escape. Ivory and rubber plugs
attached to an abdominal belt are made for this purpose. I
have used a soft rubber bag attached to a ring pessary of copper
wire surrounded by rubber tubing, and fixed by tapes carried
round the waist. After trying most of the apparatus recom-
mended for this purpose, I have come to the conclusion that
nothing is more efficient and more comfortable than clean linen
rags nicely folded, and kept in position by a well-made linen
binder. Patients themselves often devise ingenious contrivances.

Occasionally fæces collect in the part of the bowel below the
opening and give trouble. Bryant has seen symptoms of intes-
tinal obstruction produced in this way, in spite of the presence
of the opening in the bowel. To prevent the passage of fæces
into the lower segment of gut, various means have been suggested
and adopted. To increase the acuteness of the flexion of the
bowel, sutures have been placed so as to take in the greater part
of the calibre, or even (although this involves transfixion of the
peritoneum) the whole circle. Mr. P. Jones[*] has succeeded in
preventing the downward passage of fæces by turning inwards and
suturing the mucous membrane around the prolapsing portion.

* _Brit. Med. Journ._, 1886, i., p. 782.

The most thoroughgoing proceeding of this sort is that of Madelung.* He recommends that the bowel be cut completely through, that the lower opening be closed and dropped inside and the upper opening be sutured to the wound to form the artificial anus. The irritation of fæces on the cancerous rectum is thus done away with, and prolapse of the gut through the wound is less likely to take place. There is one risk attached to Madelung's proceeding which has not been pointed out; and that is, the accumulation of cancerous discharges above the stricture, which, unable to escape downwards, would certainly cause pelvic cellulitis. I have, in one case on which I had performed colotomy, seen sudden stoppage of all discharge by the anus, and appearance of it at the artificial opening. This alone would deter me from adopting Madelung's suggestion, even if the advantages to be secured were greater than he claims. Ball of Dublin has closed the divided lower segment of bowel after cœlio-colotomy, and dropped it inside the abdomen, with good result.

THE OPERATION OF CŒLIO-COLOTOMY.

Anatomical Considerations.—Here the colon is opened by an incision through the parietes, in the inguinal region usually. If performed on the left side, it is Littré's original operation. It may, however, be performed on either side—on the left, when it is desired to open the sigmoid flexure; on the right side, when it is desired to open the cæcum or ascending colon. The operation may also be carried out through a median incision: in such a case the term "inguinal colotomy," generally used for the operation, is wrong. Recent experience has made it necessary to review the position which extra-peritoneal colotomy holds as compared with intra-peritoneal. Cœlio-colotomy is steadily and surely coming into favour, and properly so. Verneuil, Ball,† Allingham (junr.),‡ and Harrison Cripps,§ are among the most conspicuous supporters of the operation,

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* *Centralbl. für Chir.*, No. 23, 1884.
† *The Rectum and Anus*, Lond., 1887, p. 362.
‡ *Brit. Med. Journ.*, Oct. 22nd, 1887. § *Brit. Med. Journ.*, April 6th, 1889.

and have introduced various important modifications and improvements.

Some observations of Anderson [*] on the surgical anatomy of the sigmoid flexure of the colon may conveniently be quoted here. Like Treves, he condemns the usual name "sigmoid" as applied to the pelvic flexure of the colon, but does not like Treves's name (Omega-loop), and simply calls it the "pelvic flexure." After specially referring to the great variations in the length of the mesentery in this part of the bowel, and to the occasional occurrence of a partial volvulus which might lead to accident in performing colotomy, he describes the course and position of the pelvic flexure as follows, illustrating the description by the accompanying drawing (Fig. 162) from a model of Professor His :
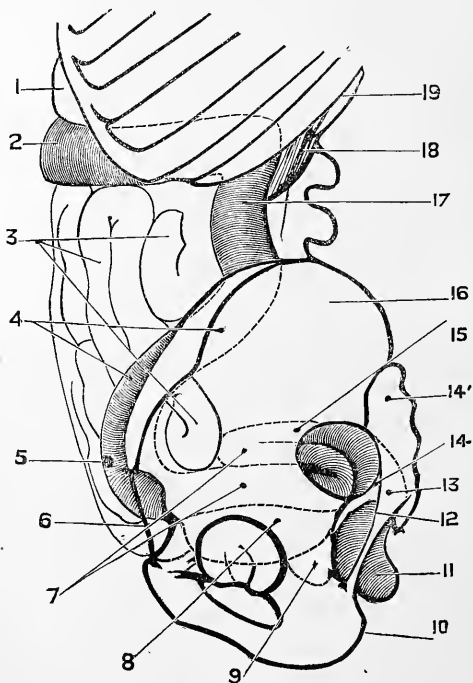
FIG. 162. (ANDERSON.)

Diagram showing course of Pelvic Flexure of Colon.

1, Stomach; 2, Transverse Colon; 3, Small Intestines; 4, Pelvic or Sigmoid Flexure, false pelvic stage; 5, Centre of incision for Left Inguinal Colotomy; 6, Poupart's Ligament; 7, Pelvic or Sigmoid Flexure, true pelvic stage; 8, Bladder; 9, Prostate; 10, Tuber Ischii; 11, Anal Canal (Rectum, 3rd stage); 12, Rectum (2nd stage); 13, Greater Sciatic Ligament; 14, Sacrum; 15, Termination of pelvic flexure (Rectum, 1st stage); 16, Ilium; 17, Descending Colon; 18, Left Kidney; 19, 12th Rib.

"The tpyical flexure may be divided into an *iliac false pelvic*

* *Clin. Journ.*, 1894, IV., p. 241.

portion—the operative segment—in the left iliac fossa, and a *true pelvic* portion lying below the plane of the pelvic inlet. The *first* portion usually runs forwards and downwards along the inner lip of the iliac crest, in close relation to the anterior superior iliac spine, and along the upper half or two-thirds of Poupart's ligament, and then dips sharply back into the true pelvis. It generally comes into contact with the muscular walls of the abdomen a little internal to the anterior superior iliac spine, and for a variable distance above and below this point in the line of the iliac crest and Poupart's ligament. In many instances, however, and especially when the mesentery is short, the colon is completely overlapped by the small intestines, and can only be found by displacing these.

"The *second* or *true pelvic* portion of the flexure runs backwards nearly at right angles to the last, crosses the inner aspect of the ureter, and, lying upon the left side of the upper surface of the bladder, extends into the recto-vesical pouch, where it becomes twisted sharply upon itself, and turns forward for three or four inches, still upon the bladder, till it comes into contact with coils of small intestine, then recurving a second time it runs back towards the hollow of the sacrum and becomes continuous with the rectum ('second stage'). The coil so formed may be really **S**-like."

The position (Fig. 162, 5) marked by Anderson as the most suitable for the centre of the incision in inguinal colotomy I would place a little higher up as well as further back. If the mesentery is short it may be difficult to bring the bowel up to Anderson's point, and it is not very convenient to have the anus so close to the iliac spine as he would place it.

Among the most important advantages of cœlio-colotomy, the following may be mentioned. The large intestine can easily be found, and can scarcely be mistaken for any other portion of bowel. The operation permits thorough exploration and accurate diagnosis: thus, not only may it be possible to proceed to a radical operation by excision, but there is absolute certainty that the opening will be made above the stricture. The operation is a smaller affair altogether; it may be performed through a

short abdominal incision, and with more expedition and less shock to the patient. The position of the wound renders it possible for the patient to dress and look after it. The only drawback is the necessary opening of the peritoneum; and this, now-a-days, is a very small one. As Ball points out, the peritoneum is opened in the lumbar operation by no means infrequently.

Operation.—The original operation was performed through an incision made parallel with Poupart's ligament, about an inch above it, starting at the iliac crest and running inwards about two or three inches. But other lines of parietal incision may be employed. Luke and Adams employed a vertical incision external to the epigastric artery, and most other surgeons have their own favourite sites of operation. As experience has not yet settled the best general mode of operation, it will be advisable to specially describe the operations of Verneuil, Ball, Allingham, Cripps, and the modification of the Maydl-Reclus operation recommended by the writer.

Professor Verneuil, who has for some time advocated the inguinal mode of performing colotomy, has introduced important modifications. To obviate the disadvantage of having no spur or heel below the artificial anus to prevent the downward passage of fæces, and to provide against the contraction of the opening, are the main purposes of his operation. The incision, two inches in length, starts about two inches to the inside of the iliac spine, and is directed upwards to the umbilicus. He catches the edges of the abdominal opening in six pairs of hæmostatic forceps, to distend the wound and prevent the peritoneum from being peeled off. Enough intestine is pulled out to make a protuberance as large as a pigeon's egg; this is transfixed with two acupuncture needles, which lie on the parietes and keep the intestine in place. About fifteen metallic sutures are placed between intestine and abdominal wall, and the protruding piece of gut is resected. The thermo-cautery is used to check bleeding. The intestinal wall, bulging into the large opening, blocks the downward passage; the

magnitude of the opening obviates the risk of stenosis; protrusion is prevented by the longitudinal direction of the parietal opening, and its comparatively small size.

Ball's mode of operating may be given in his own words: "An incision about four inches long was made in the left linea semilunaris, this position being selected for the following reasons: it freely exposes the sigmoid flexure; it is made without cutting muscle; the parietes are thinner here than elsewhere; and no vessels of importance are wounded. The deep epigastric artery is quite safe from injury if the lowest limit of the incision does not pass below a line drawn from the umbilicus to the middle of Poupart's ligament. The upper limit of the cancer having been determined, the gut was emptied upwards by careful pressure, and a loop of bowel drawn out; a narrow-bladed clamp was now applied to the intestine, so as to prevent any fæces coming down, and a similar one applied to the distal extremity of the loop. In the present case, Ricord's phimosis forceps, covered with rubber tubing, and closed by means of elastic umbrella-rings, were used for clamps. (He has since had a clamp made, which has the advantage of allowing the blades to move quite parallel. By means of a screw the exact amount of pressure necessary to retain the loop of intestine in the grasp can be applied, and bending at a double angle permits of the blade portion lying easily within the peritoneal cavity.) The clamps being applied, a number of sutures were passed through the abdominal wall, including peritoneum, on one side, through the intestine *in front of the clamp*, and through the peritoneum and abdominal wall on the opposite side. Eleven sutures were in this way passed, five perforating each portion of intestine, and one passing through the meso-colon. The bowel was now opened between two aseptic sponges, and the interior carefully cleansed of mucus and fæces. The loops of the sutures were hooked out from within the lumen of the bowel, cut, and the central ones tied on each side; the suture through the meso-colon was also tied; the sutures through the angles of the abdominal wound and outer borders of the bowel alone

remaining unclosed. A number of superficial sutures were now put in, so as to render the application of the mucous membrane to the skin extremely accurate all round, except at the angles where the handles of the clamps lay. The clamps were now withdrawn one by one, and the remaining sutures at either angle simultaneously closed, thus shutting off the opening into the peritoneal cavity at the moment that the clamps released the bowel. The single suture through the meso-colon is, I think, of use in ensuring a larger surface of peritoneum being in apposition to the abdominal wound, and the second clamp on the distal extremity of the bowel, although not as essential as the other, facilitates the operation considerably."

In Allingham's operation* the bowel is kept forward in the wound by a suture passed behind the gut and through the mesentery, and fixed in the edges of the parietal wound. He makes the parietal incision, two inches in length, about one inch inside the anterior superior spine of the ilium, and parallel with Poupart's ligament. The divided peritoneal margins he at once sutures to the skin. "This being done, a good loop of the sigmoid is drawn out and a stitch is put through the skin on one side, then through the mesentery behind the bowel, back again through the mesentery, and is then tied to the end of the suture which has passed through the skin. When this is tightened it keeps the peritoneum of the mesentery against the parietal peritoneum and quickly adheres ; thus the gut is prevented from slipping back." The gut is then sutured to the skin. The operation can be done in fifteen minutes. The gut can be opened next day if necessary.

A supplementary operation is performed to prevent prolapse. After the peritoneum has been stitched to the skin, "the gut is drawn out and is pulled upon until it is taut above, and similarly, until it is taut below ; in other words, I pull out all the slack portion of the gut, which in cases where the mesentery is lengthy may amount to many inches. All the portion that has been drawn out is then fixed outside the belly

* *Brit. Med. Journ.*, 1892, vol. i., p. 1013.

as is done in the ordinary operation. In two or three days the gut is opened so as to allow the exit of wind; and in a week or so, all the gut outside the belly is clamped with my spiked clamp close to the skin, and the portion above the clamp is cut away. In some cases the part removed has been a foot long and has weighed more than six ounces. The clamp is left on for twenty-four hours, and is then removed, no bleeding occurring." In cases of advanced cancer where the patient has not long to live, this supplementary operation is not called for.

The chief feature of Allingham's operation he considers to be the very perfect spur which it forms. Another advantage, which he does not claim, is its very low mortality. In fifty cases he had only two deaths. The chief drawback would seem to be the tendency of the bowel to prolapse, which is sometimes very great. To obviate this tendency his supplementary operation, of removing all superfluous bowel with its mesentery which can be pulled out of the wound, is devised. As many as seven inches of gut have thus been removed. As will be seen further on, I believe that prolapse can be prevented without adopting such severe measures; if this be possible, Allingham's method of operation cannot easily be improved upon.

The operation as performed by Harrison Cripps may also be given in his own words. "The patient has a warm bath the night previous to the operation, the abdomen being thoroughly cleansed with soap and water, and afterwards covered with a light antiseptic dressing. This is important; for, since the operation is usually undertaken for cancer of the rectum, the part is liable to become contaminated with the fetid discharge. I make my incision higher than most operators. The branches of the epigastric artery are thus avoided, and there is subsequently less pressure on the wound than when lower down. As a guide I take an imaginary line from the anterior superior spine to the umbilicus; the incision, two inches and a half long, crosses this at right angles, an inch and a half from the

superior spine. Half the cut is above, and half below the imaginary line. . . . In making the incision the skin should be drawn a little inwards, so as to make the opening somewhat valvular. The peritoneum being reached, it is pinched up by fine forceps and an opening made sufficient to admit the finger. The intestines being protected by the finger, the peritoneum is divided by scissors to nearly the full length of the cutaneous incision. The colon may now at once show itself, and can easily be recognised by its longitudinal bands, its glandulæ epiploicæ, and by its regular convoluted surface. . . . Sometimes it can be detected by the hard scybalous masses within it, or it can be traced up after passing the finger into the pelvis and feeling for it as it crosses the brim.

" The colon being found, a loop of it is drawn into the wound. In order to avoid the prolapse which is likely to occur if loose folds of the sigmoid flexure remain immediately above the opening, I gently draw out as much loose bowel as will readily come, passing it in again at the lower angle as it is drawn out from above. In this way, after passing through one's fingers an amount varying from one to several inches, no more will come. Two provisional ligatures of stout silk are passed through the longitudinal muscular band opposite to the mesenteric attachment. The provisional ligatures, the ends of which are left long, help to steady the bowel during its subsequent stitching to the skin, and, moreover, are useful as guides when the bowel is ultimately opened. They should be about two inches apart.

" The bowel is now temporarily returned into the cavity. With a pair of fine forceps the parietal peritoneum is picked up and attached to the skin on each side of the incision, the muscular coats of the abdominal wall not being included. Four sutures of fine Chinese silk are sufficient : two on each side, an inch and a half apart.

" The bowel is again drawn out, and fixed to the skin and parietal peritoneum by seven or eight fine ligatures on each side, the last suture at each angle going across from one side to the other. The bowel should be so attached as to have two-

thirds of its circumference external to the sutures. By turning the bowel slightly over, the lower longitudinal band can be clearly seen; and it is best to pass the sutures for the lower side through this, since it is a strong portion of the gut. The upper longitudinal band, through which the provisional ligatures have already been passed, is seen in the middle line of the wound. The bowel being now turned downwards, the opposite line of sutures are inserted close to its mesenteric attachment. The sutures, of the finest Chinese silk, are passed by small, partly-curved needles, the needle passing through the skin one-eighth of an inch from the margin, then through the parietal layer of peritoneum, and, lastly, partly through the muscular coat of the bowel, great care being taken to avoid perforating the mucous membrane. It is easier to pass all the threads before tying them up."

The wound is cleansed thoroughly, and the bowel is either opened at once if the case is urgent or covered up and opened after a few days. It is necessary to place a bandage or strapping firmly over the wound to prevent protrusion in the case of sickness.

The bowel is opened without an anæsthetic for the whole length between the provisional ligatures, and the superfluous flaps trimmed off to the level of the skin.

In this way a satisfactory artificial anus is usually formed. Occasionally the opening contracts too much, forming a fistula which permits dribbling of intestinal contents: to prevent contraction, Cripps uses a special spring dilator. Prolapse of the bowel after this mode of operating would not seem to be a frequent result; and when it occurs, it is said to be easily controlled by a compress and bandage.

Method of Maydl modified by Reclus and the Author.—Of all modes of performing colotomy, this is undoubtedly the simplest; and for most cases it will, in my opinion, be found to be the best. It may be described in one sentence as making a parietal opening, pulling the colon through the wound, passing a stiff rod

through the meso-colon close to the intestine, and opening the
gut either at once or after a day or two.

The original operation of Maydl of Vienna is described as
follows in Reclus' paper : *   "There is nothing special to note
in the line of incision above Poupart's ligament, in the opening
of the abdominal cavity, and in the seizing and drawing outside
of a loop of intestine ; this loop should be drawn out far enough
to allow the mesentery to appear.   From this point the special
details of the operation begin.   The mesentery is pierced close
to the intestine, and through the aperture is passed a stiff rod
previously rendered thoroughly aseptic.   A new exploring
bougie, goose-quill, or caoutchouc rod wrapped in iodoform
gauze, will do.   The loop of the intestine is thus secured on the
outside, and cannot be drawn back into the abdomen by the
traction of the mesentery or by movements of the diaphragm.
Maydl then sutures the two ends of the intestine by a double
row of stitches—one row in front, the other behind,—and leaves
the intestine in the wound, after having surrounded and pro-
tected it by pieces of iodoform gauze.   At the end of four, five,
or six days a transverse incision through one-third of the cir-
cumference of the intestine is made with the thermo-cautery,
and the escape of gas which takes place through this opening is
quite sufficient to give the patient ease.   After fourteen days
what remains of the intestine beyond the rod which perforates
the mesentery is removed.   This rod thus serves both to sustain
the intestine and as a guide.   The edges of the intestine may
then be sutured to the skin."

Reclus shortens the operation by omitting the sutures with
which he considers that Maydl has needlessly complicated it.
"Operating without chloroform and with cocaine as an anæsthetic
he finds that in five, six, or at most seven minutes he can incise
the abdominal wall, seize the sigmoid flexure, and draw a loop
of it outside, transfix the mesentery close to the intestine with a
thoroughly aseptic bougie, and thus complete the first stage of
the operation.   On the fourth or fifth day the loop of intestine
is slit up, and on the tenth excised."

                    * Bull. de Sociétè de Chir., Feb., 1890.

A case exhibited by Mr. F. Marsh of Birmingham, in July, 1890, first impressed on me the virtues of the operation. Six weeks later I had an opportunity of putting the method to a very severe test in a patient of my colleague, Dr. Shingleton Smith, when we were delighted with the ease of the operation and the excellence of the result. Since then I have performed the operation more than forty times, and I consider it superior to all others. It can be performed in five minutes without hurry; it provides a perfect spur; it leaves a real anus surrounded by mucous membrane and muscle both of bowel and parietes, so that there is no dribbling; and as the bowel is firmly implanted on the parietes and tightly gripped by muscle, there is no prolapse.

The Parietal Incision.—The incision through the parietes may be at any part of the abdomen which is conveniently situated for the finding and delivering of the bowel above the stricture, and for the position of an anus. It may be performed through an incision made for exploratory purposes. The most convenient situation for the anus is in either inguinal region; and after this, in the middle line between umbilicus and pubes. An opening in the transverse colon leaves an anus above the umbilicus which is not easily managed.

The operation in the majority of instances falls to be performed on the descending colon or sigmoid flexure, and hence the parietal incision is made somewhere in the inguinal region. As to length it will vary between two and three inches, according to the thickness of the parietes; long enough, that is to say, to permit of the drawing out of a loop of bowel, and short enough to avoid the necessity of placing a single suture. In position it should not be so far back as to render the toilet of the artificial anus difficult to the patient: about an inch behind the position of the anterior superior iliac spine and an inch above it is a good point at which to begin the lower end of the incision.

As regards the direction of the incision, I have come to the conclusion that the vertical or nearly vertical, with a little

backward tendency at the upper extremity, is the best. The
chief motive in direction is to avoid all division of the fibres of
the internal oblique muscle and to get them implanted intact
directly on the serous covering of the bowel. This of course
can be done whatever the direction of the incision; but it
is most readily done if the incision follows the direction of
the fibres. To leave undivided the fibres or tendon of the
external oblique I have found to be a mistake; it produces
coarctation near the orifice of the new canal and tends to lead
to stenosis. The transversalis is of little moment and may
be divided to the extent of the wound.

The skin, subcutaneous fascia, and external oblique are
divided; the fibres of the internal oblique are separated
with the finger; the transversalis is divided, and the peritoneum
is opened in the usual way.

Finding, Delivering and Fixing the Bowel.—Two fingers of
one hand inserted through the opening will probably at once
come on the bowel, which is recognised by its peculiar but
indescribable characteristics to touch. If it is not easily
discovered, the fingers may be carried along the posterior
parietes backwards from the incision, till they are checked
by the meso-colon to which the colon is attached. The
bowel is caught between the fingers and drawn to the surface
and out through the wound. The bowel is pulled down
from above so that it shall be taut between the splenic
flexure and the parietal opening.

The bowel, thus delivered, is fixed by passing a stiff rod
about six inches long through its mesentery and letting the
ends rest on the parietes at right angles to the line of incision.
Any material which is stiff and smooth and aseptic will do.
I have used a cedar pencil, a penholder, a glass tube, a
pedicle skewer with a strip of lint round it, a piece of thick
wire inside a rubber tube, and other materials. In routine
operating I use a vulcanite stirring-rod, such as is used by
chemists. This is simply pushed through the mesentery a little
way from the bowel and permitted to rest on the parietes.

The operation is now finished, if we decide to wait a day or two before opening the bowel; in any case, no more anæsthesia is necessary.

No sutures are placed. The peritoneum not only is not brought to the surface and sutured to skin and bowel, but is rather pushed inwards towards the cavity. The aim is to get implantation of the serosa of the bowel on to as large a surface of raw muscle and fibrous tissue as possible. The motive is the same as has been already urged for the operation of gastrostomy, and the reasons are the same, so the arguments need not be recapitulated.

I have on various occasions used devices to keep the lower loop of bowel well down in the incision. On several occasions I have kept the rod downwards by fixation to strapping; a few times I sutured the parietes through the divided mesentery; once or twice I tried Allingham's method; but all were found superfluous. The firm, unyielding rod is quite sufficient. The upper bowel makes room for itself, crowds the lower loop downwards as far as is necessary, and accurately fits the space provided for it. The bowel cannot be drawn backwards into the cavity, and if the dressing is properly applied no bowel can be extruded. In spite of the most violent intestinal contractions and the greatest straining on the patient's part, experience has abundantly proved that the bowel is kept in its position. In two days it will be so firmly fixed all round the incision that the rod may be removed. However, to add to the perfection of the spur, the rod is best retained for a week or even longer.

Opening of Bowel. Formation of Anus.—It is a matter of almost complete indifference whether the bowel is opened at once or there is a delay of a few days till adhesions are complete. If there is any collection of fæces, five minutes or ten may profitably be spent in emptying the colon after incising it in the manner described for enterotomy. In a case of cancer of the rectum I have removed about twenty hard fæcal lumps which literally mapped out the course of the

colon through the parietes before operation, right up to the hepatic flexure. To permit the outflow of some portion of an enormous accumulation of semi-liquid or liquid fæces before fixing the intestine and inserting the tube is to spend the time profitably. In most cases, however, the drainage tube may be inserted at once with an assurance not only that no risk is thereby incurred, but that comfort is thereby induced.

If it is decided to leave the bowel unopened for a few days, the following plan may be adopted. A piece of gutta-percha tissue large enough to cover the extruded bowel but no larger, is laid over it. Then a coil of boric lint is wound round the protruding loop, so as to make a scaffolding high enough to prevent the bowel from being compressed by the overlaid strapping, and closely enough applied to prevent the extrusion of more bowel. Over all is placed an interdigitating double strip of adhesive plaster, which is carried round the back to render security doubly secure (Fig. 156). Gas may pass along beyond the skewer if the dressing be properly applied.

After two or three days the bowel so fixed is opened. I am doubtful whether it is better to open the bowel by complete division by scissors or scalpel carried through the track made by the supporting rod, or by a vertical incision carried through the outer wall of the projecting loop. Complete division of the bowel is theoretically the more perfect, at all events at the beginning; but at the end of two months there is little to choose between the two proceedings. After division the lower loop atrophies and is drawn downwards, often out of sight; while the upper loop falls back almost flush with the parietes. This is not an unmixed advantage. The best anus is a pouting one, where the apex of the mucous membrane is at least half an inch above the level of the parietes. With such an anus a cup-shaped apparatus easily collects the fæces and is kept in place without difficulty. An anus which is flush with the parietes permits the fæces to run over the skin and gives no help in the holding of a receptacle. Therefore I like to get an anus which has a pouting mucous

membrane broader at the apex than at the base. Such an anus is well formed after simple vertical division of the gut on the convexity of the loop. The sides retract and become covered with epithelium. The spur and the surrounding mucous membrane protrude and form an anus very like the natural one. The opening into the lower bowel is small, but it is there and almost on a level with that into the upper bowel. The possible advantage of this latter fact in the case of upward forcing of discharges from the growth is self-evident, while the facility afforded for the topical application of hæmostatics or antiseptics to a foul or bleeding cancer is not to be disregarded.

Where the opening is delayed for a few days no tubing is necessary; where the opening is made at once, the use of tubing is advisable. The method of operating then followed is shown in Fig. 163, and is the same as has been described for permanent enterostomy (p. 689). As already stated, I have no hesitation whatever, if there is the slightest urgency, in evacuating the intestinal contents, in making the opening at
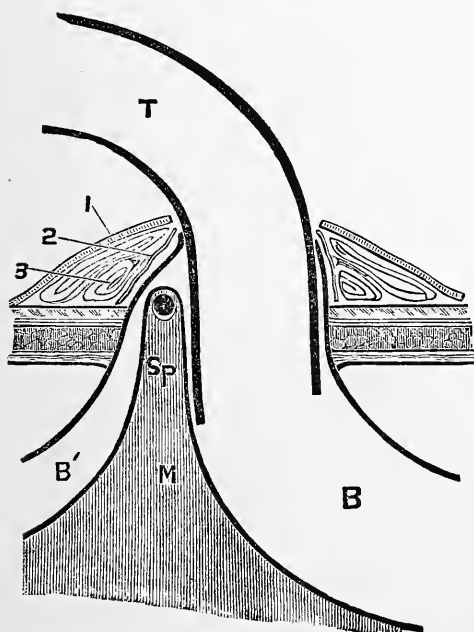
FIG. 163.

Diagram to Show Method of Colostomy.

B, Bowel on proximal side of Spur. B', Bowel collapsed below Spur. T, Rubber Tubing. Sp., Spur; at the top the black circular spot represents a section of the supporting rod. 1, Strapping. 2, Gutta-percha Tissue. 3, Absorbent Dressing.

the time of operation. I have not found that it adds at all to the risk as compared with cases of operation in two stages; indeed, it is almost certain that immediate opening in the cases selected for the operation has positively diminished risk.

After-treatment.—The after-treatment relates chiefly to the local management of the wound in the first place, and of the anus subsequently. In cœlio-colotomy, if the dressings are properly applied from the beginning, primary union practically always occurs. In lumbar colotomy done in one stage, the employment of antiseptics and frequent cleansing will be necessary to prevent suppuration. If suppuration occurs, the wound is treated on ordinary principles.

The successful management of the anus adds greatly to the comfort of the patient. The best anus is, in my opinion, a pouting one, in which a long mucous tube is gripped by parietal muscle. Such a tube never dribbles; it yields only to intestinal contraction behind it. I have noticed that the natural action
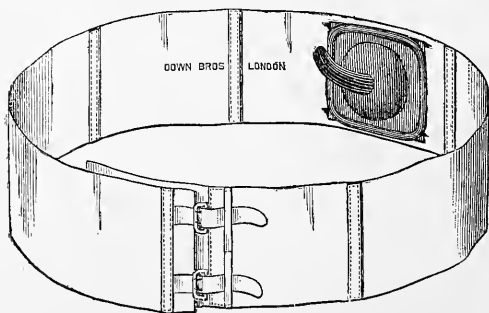
FIG. 164.

Belt with Rubber Pad for Lumbar Colotomy.

of the bowels may be encouraged by relaxing the internal oblique, and delayed by contracting it by lateral movements of the body. To collect fæces from such an anus, a rubber cap attached to an inflated ring pessary serves the purpose admirably. The cap is fixed round the waist by a belt, and it contains antiseptic absorbent wool. The pouting mucous membrane prevents displacement of the ring. The use of a belt for lumbar colotomy (Fig. 164), or of an inflation ball

(Fig. 165), to be inserted into the bowel, may be called for if the anus is not a good one, or if there is prolapsus. Patients sometimes succeed in inventing satisfactory apparatus for themselves. Dilating apparatus, where stenosis occurs, may be employed. Each anus must be treated on its merits: the surgeon will always be able to help the patient in any difficulty with its management.

In most cases the patient will have to attend to the anus himself. This will usually best be done during the period of dressing in the morning. A seidlitz powder taken on waking, followed by a cup of hot tea or coffee, will often succeed in procuring a thorough evacuation, when there will be no further action during the day. During the first free evacuation a special large rubber bag, with absorbent wool inside, may be worn ; for the rest of the day a small bag will suffice.

FIG. 165.

Jacobson's Colotomy Plug.

The comfort of a patient with an artificial anus depends greatly on the combined care of the surgeon and the instrument maker. If the surgeon has provided a really satisfactory anus that does not permit prolapse and is well gripped by muscle, the instrument maker will easily provide an apparatus which will permit the patient to join freely in ordinary social life.

Operations for Artificial Anus and Fæcal Fistula.

Anatomical Considerations.
Indications for Operation.
Operative Treatment.
  By Plastic Closure.
    In Fæcal Fistula.
    In Artificial Anus.
  By Enterectomy.

The treatment of the artificial anus, which may result from any of the above operations, demands separate consideration. In those cases where the formation of artificial anus is all that was intended by way of prolonging life, all that can be done is o attend to the hygiene of the opening. In others, the formation of false anus was simply one step towards the permanent cure: and the closure of this opening is attempted at the proper time. In other cases, a false anus, or rather a fæcal fistula, may result from the yielding of stitches after enterorraphy, and an operation to cure this fistula may be forced upon us.

Anatomical Considerations.—A false anus may be described as an opening in the bowel which forms a communication, through the parietes, between the intestinal canal and the open air. The bowel around this opening is adherent to the parietal peritoneum over a varying extent and by tissues of varying thickness and density, according to the amount of original inflammation and the standing of the case. The opening in the parietes to which the gut is adherent is of varying depth and size, according to the thickness of the parietes and the position where the bowel has become adherent. Its margins are puckered and depressed, and the skin around it is red and excoriated. Sometimes there are two such openings lying close to each other. The conditions of greatest practical importance are, the amount of bowel which has been lost, and the degree of flexure of the two intestinal tubes upon them-

selves. In cases where artificial anus has been made after resection of bowel for gangrene or disease, two pieces of intestinal tube lie parallel, and separated from each other by their double adherent walls. The end through which fæces pass will be dilated; the lower end will be collapsed, shrivelled, and empty. Between this condition of parallelism with destruction of bowel, and mere slight bending with a hole in the side of the gut, there are many varieties. The accompanying diagrams (Fig. 166) give some idea of these varieties. In most cases, the continuity of the bowel above and below the fistula is interrupted by a spur or septum (*éperon* of Dupuytren), formed by the intestinal walls bent inwards. This spur varies in dimensions from a mere elevation or flap (Fig. 166, II.), to a complete barrier to the

FIG. 166.

Diagrams to show varieties of Artificial Anus.

U. Upper Bowel. L. Lower Bowel. I. Fæcal Fistula, there being no spur. II. Fæcal Fistula with Spur. III. False Anus with Spur, which completely shuts off the Upper from the Lower Bowel. IV. Double Fæcal Fistula.

passage of fæces. (Fig. 166, III.) It increases in size with the duration of the case, being dragged down by the fæces and pushed over the lower collapsed bowel. The upper bowel itself, from its constant discharge of function, becomes increased in size and more vascular; while the lower portion may become shrivelled to the size of fœtal life. Hence, it is

important that any operative procedures should be done early. The existence of this spur is the chief practical difference between false anus, which discharges the whole of the intestinal contents, leaving nothing to pass into the lower gut, and fæcal fistula, which may be a mere opening in the gut without flexure upon itself, and permitting extravasation of only parts of the contents. In the cure of false anus, this spur is the chief obstacle : if fæcal fistula does not spontaneously heal, some operative proceeding is necessary.

The *indications for operation* in fæcal fistula may be much stronger than a mere desire to get cured of a worrying or loathsome complaint. If the opening is high up in the bowel, rapid emaciation from escape of the chyle, and death from inanition, may be apprehended. The urgency of symptoms arising from escape of nourishment will depend upon the situation of the opening ; but it seems to be a very general rule that wasting is to be expected if the opening is anywhere in the jejunum or upper part of the ileum. Besides this danger, patients with false anus are liable to have prolapse of the bowel through the opening, or even to ordinary hernia.

As an aid to the *diagnosis* of the situation of the intestinal opening, Senn's method of inflation by hydrogen gas may be employed with advantage. If the gas escapes quickly, and there is no audible gurgling in the cæcal region, the fistula probably enters the large bowel. If the gas does not escape till after an interval, and if gurgling is heard as it passes the ileo-cæcal valve, the opening is probably in the small bowel.

OPERATIVE TREATMENT.

In the case of simple fistula, it is presumed that all minor measures, such as curetting the opening and suture, the use of the actual cautery, and pressure, have been tried and found ineffectual. In the case of true artificial anus, operative measures are nearly always essential. The operative methods employed have been very numerous : two methods are here described ; namely, (1) Plastic Closure by an extra-peritoneal

operation; and (2) Resection of the intestine involved in the fistula and junction of the free ends.

PLASTIC CLOSURE OF FÆCAL FISTULA AND ARTIFICIAL ANUS.

The method described is one which has been employed by the author during the past few years with uniform success. It is almost entirely free from danger, is entirely extra-peritoneal, and results in a perfectly satisfactory restoration of the functions of the bowel.

The aim of the operation is to perform enterorraphy without opening the general peritoneal cavity; and this is managed by detaching from the parietes, all round the fistula or anus, sufficient peritoneum to permit of delivery of the gut through a parietal incision without separating it from its adhesions to the peritoneum. The importance of having the operation extra-peritoneal will at once be admitted, and the advantages arising therefrom need not be dwelt upon. Any objection to the method would probably arise from the fact that the intestinal suture is made, not in the time-honoured manner by junction of serous surfaces, but by apposition of rawed surfaces which may even be cicatricial. The best answer to such an objection is the practical one that union is just as easy by junction of rawed surfaces as of intact serous surfaces. It may further be added that intimate union and permanent organisation of the uniting medium is more perfect after junction of the rawed surfaces. The arguments for and against serous junction and fibrous junction have already been sufficiently put forward and need not be here reproduced; the fact that the union is easy and satisfactory is all that need be insisted upon.

Between the parietal peritoneum and any discharging in-testinal opening is a circle of adhesions binding the bowel to the parietes. These adhesions are left intact. The bowel is delivered through an incision carried above and below the parietal opening along with parietal peritoneum, which is separated from parietes to any extent desired. The chief

element in the operation is this separation of parietal peritoneum, with its fat, all round the fistula. It is remarkable how much freedom for manipulation a peritoneal stripping of an inch all round will give. A stripping over a circle of two inches radius will permit the gut to be delivered completely

through the wound. The detachment is begun at a distance from the fistula, and carried down to it; it may be done almost entirely with the fingers. Further details may now be given.
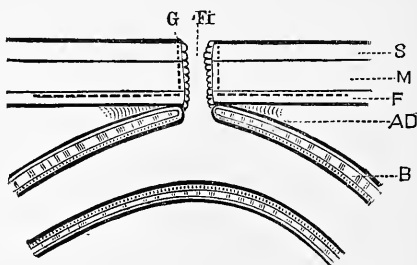
FÆCAL FISTULA.

Here the bowel does not protrude through the parietal opening, and there is no spur, or only a slight one. A simple fistula lined with granulations leads from skin to bowel.

The granulations are first scraped from the sinus by means of a small sharp Volkmann's spoon, and the parts around are purified. If there is any discharge from the intestine, a
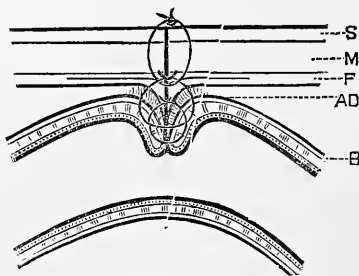
FIG. 167.

Diagrams to show method of Closing Fæcal Fistula.

Fi. Fistula in abdominal wall communicating with bowel. G. Granulations lining fæcal fistula. S. Skin. M. Muscular layer. F. Sub-peritoneal fascia. AD. Adhesions between bowel and peritoneum surrounding fistula. B. Bowel.
Broken line in upper diagram shows incisions around fistula and in sub-peritoneal areolar tissue. Lower diagram shows operation finished and sutures placed.

small sponge with string attached is pushed through the fistula so as to block it.

Two incisions are now made in the parietes, with the fistula as centre, down to the sub-peritoneal areolar tissue. Their direction is to be guided by that of the principal muscular fibres

in the parietes, so as to avoid their division and thus minimise weakening of the parietes. A fistula in the middle line would have vertical incisions above and below it; in the loin it would be vertical or oblique, as we desire to preserve the fibres of the internal oblique muscle, or external oblique muscle and apon-eurosis. The incision comes up to, but does not pass through the fistula; it is carried round the fistula; the fistula with the cicatricial tissue surrounding it is bodily removed. The parietal incision goes down to the sub-peritoneal areolar and fatty tissue, but does not go through it. Then with finger and scissors the parietal peritoneum with its fat is detached from the muscle all round the fistula for a distance of from one to two inches. When the separation is complete, the fistulous tract is removed down to the gut. The bowel remains attached to the parietal peritoneum by adhesions around the fistulous opening. By means of forceps placed close to the opening, the bowel, with its attached peritoneum, may now be lifted out · through the incision in the parietes. If there is any difficulty in doing this, a little more detachment of peritoneum will make it easy. The opening in the gut is now closed by infolding of the rawed areolar surfaces around the fistula and suturing by Lembert's method, as if smooth peritoneal surfaces only were involved. The line of closure may be vertical or transverse, as seems best. Two layers of closely placed sutures, one con-tinuous (Dupuytren), suffice for closure. The outer row will engage some of the sub-peritoneal areolar tissue, and should have a considerable grip of material. The sutured gut and peritoneum is pushed inside, and the parietal wound closed over it by silkworm gut sutures in the ordinary way. A small drain-age tube laid over the line of gut suture adds to the security by preventing burrowing of fluids in case of leakage.

<center>ARTIFICIAL ANUS.</center>

Here the intestine itself forms the surrounding of the fistula; the mucous membrane of the bowel and the skin are practically continuous. There may be ectropion of intestinal mucous

membrane or of the whole bowel. There will always be a spur more or less perfect, and, according to its perfection, requiring previous treatment. If there has been loss of bowel from resection or gangrene the spur will be dense and unyielding, but it need not be so large as when it is made simply by kinking.

In every case where the spur is well developed or where the intestine below the artificial anus is contracted it will be wise to devote a few days before operation to the amelioration of both conditions. For these purposes I have found Mitchell Banks' ingenious method, by means of a piece of rubber tubing, quite efficient. The tubing, if introduced on the stretch, may be of considerable dimensions. It rests comfortably in the large afferent gut ; dilates the contracted efferent gut, and presses back the encroaching spur (Fig. 168). It is kept in position by a loop of aluminium wire, which is passed into, but not through, the wall of the tube, and is bent over the parietes by the side of the opening. This wire, if strong and fixed to the parietes by strapping, will prevent the tube both from being
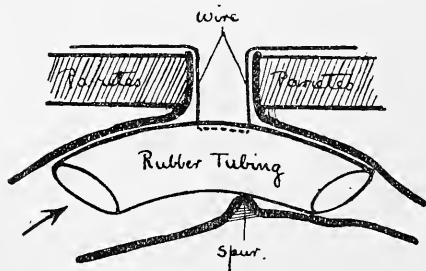
FIG. 168.

Diagram to show Banks' method of Reducing Spur and Dilating Contracted Bowel in Artificial Anus.

extruded and from being carried down the bowel. The tubing sets up some intestinal catarrh with secretion of mucus, and it may cause some pain. In most cases it can be borne with or without the assistance of opium. In a few days the spur will be reduced, and the lower gut will be dilated. A couple of days' rest may be given to the irritated intestine before operation.

The operation is begun as in that for fistula, by making incisions along the direction of the chief muscular fibres on each side of the opening down to the sub-peritoneal tissue. The length of the incisions will vary according to the thickness of

the parietes, but will not be shorter than two inches on each side of the anus. The knife is carried round the gut adherent to the parietes, liberating it thoroughly. The peritoneum, with its areolar tissue, is separated from the overlying muscle all round over a circle of two inches radius or more. The bowel, with its adherent parietal peritoneum is then delivered through, the incision. All superfluous pieces of tissue are removed and the gut is ready for suture.

Usually union is best made transversely. If there has been resection of gut, transverse suturing is essential. If there has been only incision of bowel, as in colostomy or enterostomy, suture may be longitudinal; but even here it is perhaps best done transversely. I have succeeded equally well by each method.

FIG. 169.

Diagrams to show method of Closure of Artificial Anus.

B. Bowel. S. Spur. S. Skin. M. Muscular layer. F. Sub-peritoneal fascia. AD. Adhesions between bowel and peritoneum and between peritoneal surfaces of spur.
Broken line in upper diagram shows incisions around gut forming anus, and in subperitoneal areolar tissue. Lower diagram shows sutures in place, and operation finished.

Sutures are carefully placed by the Lembert method from behind forwards. Particular care is given to the deep suturing. A good hold of the tissues is taken, and each stitch must bring about accurate apposition. A single or double row of sutures is

placed over the deep row, and here also perfect closure, without undue compression, must be secured. Tension may be avoided by complete liberation of the bowel from surrounding adhesions, and by further stripping of parietal peritoneum. The gut is closed exactly as in enterorrhaphy by Lembert's method inside the peritoneum ; only there being more available tissue for union, a more extensive grip is taken by each suture.

The wound in the bowel is cleansed ; and the whole is pushed inside the cavity. The parietal wound is closed as before. A drainage tube placed over the line of intestinal suture will guard against infiltration if there is leakage. In one case (after resection) where there was leakage (caused possibly by constant vomiting for many hours from the anæsthetic) the fistula spontaneously closed without much trouble.

In conclusion, I may add that the operation, safe and satisfactory as it is to the patient, is not a very easy one for the surgeon. The most important detail is liberation of the gut by detachment of the parietal peritoneum. If detachment is well begun at the distal ends of the incisions, and the plane of separation is followed up to the very margin of the fistula or anus, the operation is much simplified. In my first operations I began the detachment from the edges of the fistula ; this is not so easy, and may lead to opening of the cavity. Free detachment of parietal peritoneum, with accurate suturing of the bowel, are the most important elements of success.

Other methods of removing the spur than the simple one of Mitchell Banks have been employed, and a good many cases of cure simply by removing the spur have been recorded.

Gradual division of the spur by ligature has been recommended and practised by several surgeons. A ligature is passed through the base of the spur, and made to cut its way through. As we cannot always be certain that peritoneal surfaces are in adhesion at the base of the spur, this thread may be carried into the peritoneal cavity and set up peritonitis. Dupuytren lost a patient through peritonitis, after the use of the scissors to

complete a cure by ligation, and he abandoned this method. It is not a plan to be recommended.

Destruction by the Enterotome.—Since the introduction of this instrument by Dupuytren, and the great success that followed its use, the mode of destroying the spur by slow crushing has enjoyed a considerable amount of favour. Dupuytren's well-known instrument (Fig. 170) has been modified and improved by Blasius, Delpech, Reybard, Gross, and others. Probably the best of these is Gross's enterotome, which not only divides the spur, but removes it. Its structure is simply that of a large torsion forceps, the points of which are transformed into two circular opposing rings. These are made to include the spur, and are left till the compression of the blades cuts their way through, removing the greater part of the spur between them. As the compressed portion sloughs away, protective inflammation is set up in the neighbouring peritoneum. In a very few cases, however, perforation has been caused by the enterotome, and death has resulted. This ought to make us careful in ascertaining that there is a spur with at least some amount of adhesion between its parts. The results of Dupuytren's method of operation are very favourable. Herman[*] collected records of 84 cases, with a mortality of only 8.5 per cent., a complete cure in 50 cases, and in 26 considerable improvement. The mortality is so small, and the results (if trustworthy, which is just doubtful) so good, that the method of treatment may be adopted, where feasible, before having recourse to more hazardous proceedings.

FIG. 170.

Dupuytren's Enterotome.

After either of the above proceedings it may be necessary to close up the opening by a plastic operation.

[*] *Lond. Med. Rec.*, 1883, p. 187.

ENTERECTOMY FOR ARTIFICIAL ANUS.

Resection and Suture of the Intestine is a grave and difficult proceeding, to be adopted only when other methods fail, and when the patient is losing ground from the effects of the complaint. It may be indicated in cases where there are several fæcal fistulæ, with several openings in the bowel which cannot be closed by the ordinary modes of treatment. In cases of large loss of substance of one side of the bowel, without flexure and without the existence of a spur, resection may from the first afford the only prospect of cure. Again, when there is extensive prolapse of the mucous membrane which cannot be controlled, and which is causing ulceration or inflammation of the bowel, resection may be indicated.

Mr. G. H. Makins * has made a laborious and complete list of all the recorded cases of enterectomy for artificial anus. Out of 39 cases where the operation was performed for this purpose, 15 (38.4 %) died of the operation. Of the fatal cases, 9 died of septic peritonitis—5 of which were from fæcal extravasation, in 3 cases from the mesenteric border. Of the 24 that recovered, 3 were left with artificial anus. These results are sufficiently encouraging, and more than justify the proceeding in cases such as those indicated.

The proceeding so carefully planned and so skilfully carried out by Makins, seems to me to fulfil, as far as possible, the best principles of surgery, and the following description is based on his account of his case :

Preliminary proceedings, to permit of operation with an empty bowel and a pure wound, will be instituted. For a couple of days or so before operation the patient is to be fed upon nutrient enemas, all food by the mouth being withheld. Just before the operation the bowel may be irrigated with warm water till the fluid returns clear. If it is possible to wash out the lower bowel as well as the upper, this had better be done. The fistula and the parts surrounding may be kept soaking for twenty-four hours or so before operation in carbolic lotion, as

* *St. Thos. Hos. Rep.*, p. 181, vol. xiii 1884.

strong as can be borne without causing smarting—probably about 1–30. When the patient is anæsthetised, the surrounding skin is to be scrubbed, first with turpentine and then with 1–20 carbolic lotion, by means of a nail-brush. All granulations are to be scraped off or scrubbed off, and their site thoroughly purified.

An incision, vertical by preference, is made through the abdominal walls for about an inch and a half on each side of the fistula—more or less, as circumstances render expedient. The cavity being opened, the condition of the entering and returning bowel is inspected—their relations, the amount and nature of the adhesions present, and so forth. The ends are now care-fully dissected away from their adhesions, liberated, and drawn through the wound. After the abdominal cavity is opened, the risk of extravasation of the intestinal contents may be pre-vented by the insertion of a sponge, or the placing of two clamp-forceps round the wound, or, perhaps best of all, by grasping the bowel around the opening by a Nélaton's or other suitable forceps and leaving it attached there. When the bowel is pulled out so far as to give freedom for the application of the sutures after it has been resected, the abdominal cavity is to be closed as far as possible by the packing in of sponges. A large sponge would with difficulty be inserted; but several strips of flat sponge, or several small sponges tied together, will serve the same purpose. When the opening is satisfactorily closed, the clamp-forceps are put on—one on each side of the two incisions —and the bowel, with the fistula in it, is cut away with scissors beyond the site of the old adhesions. The mesentery being united by a double row of continuous suture if a triangular piece has been removed, or by a purse-string suture if no mesentery has been removed, the suturing of the divided ends is now proceeded with. If the two ends of bowel are of very different calibre, as is frequently the case, some difficulty in getting apposition may be apprehended. The lower opening may be gently dilated to a slight extent by the fingers, and this may suffice; but it may be necessary to cut the lower bowel obliquely away from its mesenteric attachment, so as to increase

the area to be sutured.   The suturing is carried out exactly as
for ordinary enterectomy, already described.

In making the intestinal junction the employment of bone
cylinders or of Murphy's button in the manner described under
Enterectomy would, by many surgeons, be considered advisable.

If, after the bowel has been sutured, it is found impossible
to bring together the edges of the fistulous opening, it may be
wise to complete the closure of the abdominal wound by a
plastic operation.   As to dressing, nothing need be added to the
accounts already given.

Appendicitis.

History.
Surgical Anatomy.
Causation.
    External Hernia.
    Adhesions.
    Casual Misplacements.
    Constriction of Lumen.
    Foreign Bodies.
    Influence of Micro-organisms.
    Traumatic Influences.
Pathology.
    Catarrhal Appendicitis.
    Ulcerative Appendicitis.
       Peritonitis.
          Diffuse Perforative.
          Local Suppurative.
          Local Adhesive.
Symptoms and Diagnosis.
    In Perforating Appendicitis.
    In Purulent Appendicitis.
    In Simple Appendicitis.
    In Relapsing Appendicitis.
Mortality. Indications for Operation.
Operation Described.
    In Perforation with Diffuse Peritonitis.
    In Purulent Appendicitis.
    In Simple Plastic or Relapsing Appendicitis.
After-treatment.

By this is meant Inflammation of the Appendix vermiformis cæci. Operations are done for certain inflammatory affections originating in this body, which cause danger to life or disablement.

History.—Although, for many years, there have been buried in our literary records fairly accurate accounts of the dangerous inflammations of the vermiform appendix, it is only within the last decade that systematic surgical endeavours have been organised to meet them. As usual, our advance has to be credited to the operating theatre, and not to the pathological laboratory. Our knowledge of the disease, as well as our treatment of it, may truly be reckoned as a direct outcome of the pioneer spirit of abdominal surgery.

Up till quite recent times all inflammations in the right iliac fossa were classed together as originating in the cæcum, and were known vaguely as "typhlitis," "peri-typhlitis," and "para-typhlitis." Pathology was satisfied with the origin in or near to the cæcum; the influence of the appendix in the production of such inflammations was either unknown or ignored. It is true that several authorities had called prominent attention to the part that the appendix played in these inflammations. Thus Copland in 1834, in his widely-read dictionary, and John Burne in 1837, gave accurate descriptions of perforative appendicitis and its consequences. Burne went further, and sought to dethrone the cæcum from its position of uniform cause in these inflammations. Others, such as Grisolle, Albers, Voltz, Rokitansky, Lewis and Wister, followed on the same lines, adding to the proofs that the appendix was a very important factor in the causation of "iliac phlegmon." But their writings had little attention and bore less fruit. With of Copenhagen (1880), of recent writers, has been perhaps the most outspoken in the expression of his belief that the appendix and not the cæcum is at the root of the inflammatory mischief we meet in the right iliac region, and he has formulated a treatment as well as a pathology to which no exception can be taken to-day. But his work did not have the attention it deserved.

The real foundation of our modern knowledge and management of appendicitis was laid by Fitz of Boston;* and the best part of the superstructure has been built up by his brethren on

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* *Trans. Amer. Assoc. Phys.*, 1886.

the other side of the Atlantic. In England, Treves has clearly differentiated and provided us with rules for the treatment of one important variety of appendicitis. The disease and its treatment has now a literature which is certainly not unworthy of its importance. Talamon, Fowler, Kelynack, and Hawkins by their monographs; Osler and Fagge in their text-books; Weir, McBurney, Keen, Bull, Bryant, and many others by their clinical and pathological records have provided ample means for the elaboration of clinical, pathological, and therapeutic data on which to found rules for diagnosis and treatment.

Surgical Anatomy of the Appendix Cæci.—The surgery of the appendix is intimately connected with its normal structural anatomy, naked-eye and minute; it has, moreover, a special and peculiar connection with its abnormalities, and particularly as regards position.

In length the appendix cæci varies between 1 and 9 inches. The average length is, in males, about $3\frac{1}{2}$ inches; in females, about $3\frac{1}{10}$ inches. It seems to be longest at or near to puberty, and to diminish with age. Its diameter is about $\frac{1}{4}$ inch in the male, this being greater than in the female by about $\frac{1}{10}$th of an inch. Bryant* pointed out that the greater the diameter of the appendix, the greater was the probability of its containing foreign materials; a diameter of $\frac{5}{16}$ths of an inch was found in no less than 89 per cent. of the cases examined to be associated with the presence of fæcal or other matter in the tube. The calibre being greatest in males at puberty, might thus explain the greatest frequency of the disease in such.

It is a fact of supreme surgical importance that, in a certain proportion of cases, constriction or obliteration of the tube is found. Hawkins † in 100 bodies found local obliteration in 4, and complete obliteration in 1. Treves in 100 bodies found local obliteration in 2, and complete obliteration in 1. Kelynack in the same number of cases found the proportions 21 and 2; Rolleston in 213 bodies, 17 and 14; and Ribbert in 400 bodies found 25 per cent. with strictures. The fact of occasional

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* *Ann. of Surg.*, 1893.   † *Dis. of Vermiform Appendix*, Lond., 1895..

stricture or occlusion is proved beyond doubt; the want of harmony in the figures may be explained by the want of agreement as to what constitutes stricture amongst the observers.

The position and relations of the appendix have received much attention in recent years. Treves, Bryant, Lockwood and Rolleston and Struthers, in particular, have made elaborate studies on the subject. These cannot here be quoted in full; and the summary must be short.

We may consider the relational anatomy of the appendix in respect of:

    (1) Its position with regard to the cæcum.
    (2) Its direction.
    (3) Its relation to the neighbouring peritoneum.

(1) The position of the appendix with respect to the cæcum, or in so far as its position is determined by the shape of the cæcum, is well shown in the accompanying Figures designed by Treves (Fig. 171). In A. is seen the fœtal type of cæcum with
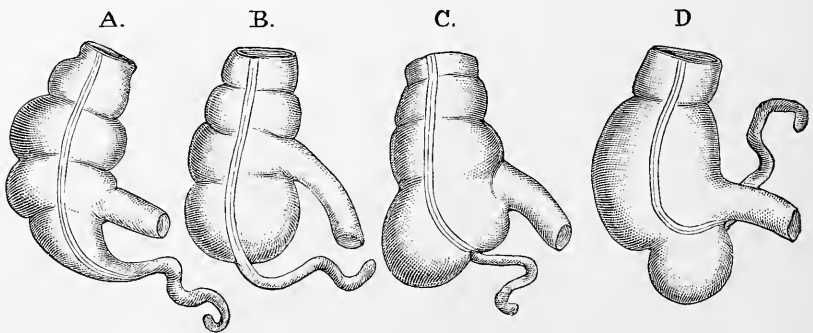
FIG. 171. (TREVES.)
The Four Types of Cæcum.

the appendix arising from its apex. In B. the cæcum is symmetrically quadrilateral, the longitudinal bands retaining their relative positions and the appendix arising between two bulging sacculi. In C. the part of the caput coli to the right of the anterior band is much larger than that to the left, and the anterior wall

is more developed than the posterior. This is the usual type of cæcum. In D. the development of the cæcum to the right of the anterior band is excessive, while to the left the segment has atrophied. Here the root of the appendix is carried behind the angle of junction of the ileum and cæcum.

(2) In regard to the position as regards direction the variety is truly endless. The appendix "may be placed anywhere." (Hawkins.) As a matter of fact the probabilities of position have less importance to the surgeon than the improbabilities; for it happens that the most rare abnormalities in position are most likely to be associated with disease. Roughly speaking, in about one-third of all cases the appendix runs upwards and inwards (type C.); in one-fourth it lies behind the cæcum, and in about one-sixth it dips into the pelvis. The records of actual operation for appendicitis show that it may be adherent to every contiguous organ and placed in a bewildering variety of situations. So far as surgery is concerned, no classification of positions yet devised is of any real value.
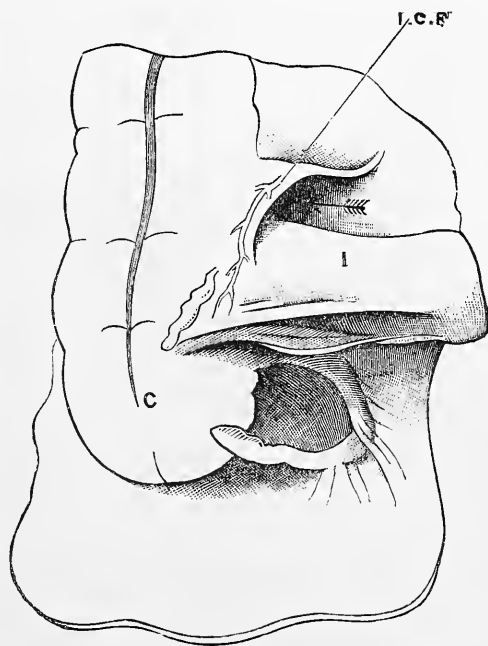
FIG. 172. (LOCKWOOD AND ROLLESTON.)

The Ileo-colic Fossa. The arrow marks the Fossa.

C. Cæcum; I. Ileum; I.C.F. Ileo-colic fold.

(3) The anatomical arrangement of the peritoneum in the cæcal region has a close and important bearing on the surgery

of the appendix. On the disposition of the peritoneal layers and folds around the appendix depend the position of a peri-appendicular abscess and the encapsulisation or safe isolation of a dangerously inflamed appendix.

The first point of importance relates to certain folds with intervening hollows or fossæ which lie between the ileum and
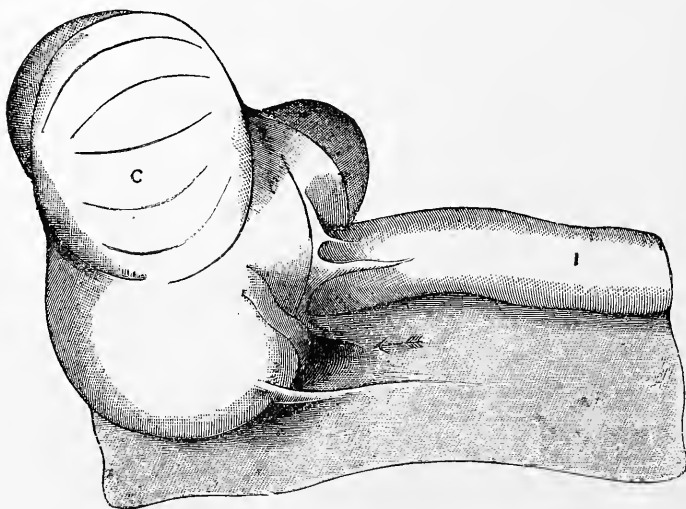
FIG. 173. (LOCKWOOD AND ROLLESTON.)

The Ileo-cæcal Fossa, to illustrate Retro-peritoneal Hernia of the Vermiform Appendix into the Ileo-cæcal Fossa. The arrow marks the Fossa.

I. Ileum; C. Cæcum.

the cæcum and behind and below the cæcum. Lockwood and Rolleston,* who have exhaustively studied the subject, describe three such fossæ : the ileo-colic, the ileo-cæcal and the sub-cæcal.

The Ileo-colic Fossa (Fig. 172) lies in the upper angle at the junction of the ileum and the colon. The angle thus formed is often partly roofed over by a fold of peritoneum, in which courses the anterior ileo-cæcal artery.

The Ileo-cæcal Fossa (Fig. 173) lies behind the junction of the

* *Journ. Anat. and Phys.*, xxvi., p. 130.

ileum and cæcum, between this and the mesentery of the
ascending colon. Its orifice is exposed by raising up the
cæcum with the entering ileum. This fossa may be very deep,
rising behind the colon as high as the kidney. Occasionally the
mesentery of the appendix divides the fossa into two, superior
and inferior (Fig. 176). Not unfrequently the appendix lies in
the fossa, and then the results in inflammatory disease are of a
nature which are easily understood.
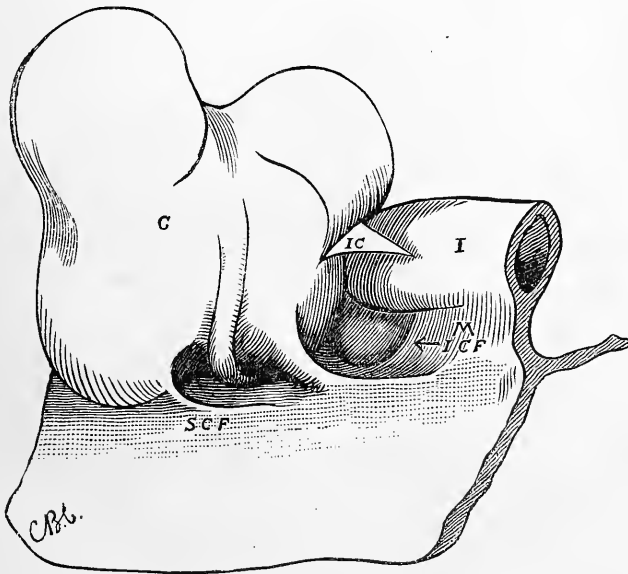
FIG. 174. (LOCKWOOD AND ROLLESTON.)

Sub-cæcal Fossa, shewing a Hernia of Vermiform Appendix into it.

C. Cæcum; I. Ileum; I.C. Ileo-cæcal Fold; I.C.F. Ileo-cæcal Fossa; the arrow points
into the Fossa; M. Mesentery; S.C.F. Sub-cæcal Fossa.

The Sub-cæcal Fossa (Fig. 174) lies immediately behind the
cæcum, separating the layers of the meso-colon. Its importance,
in the case of hernia of the appendix into it, is self-evident.

The cæcum itself is completely covered by peritoneum and
has no mesentery. The appendix has nearly always a mesentery,

more or less completely developed (Fig. 175). It springs from
the lower (left) layer of the mesentery of the ileum ; on the
outer (right) aspect is applied to the ileo-cæcal junction ; on
the inner side it forms a crescentic free border in which courses
the artery of the appendix. There is considerable variety in
the anatomy of the meso-appendix. It usually extends to near
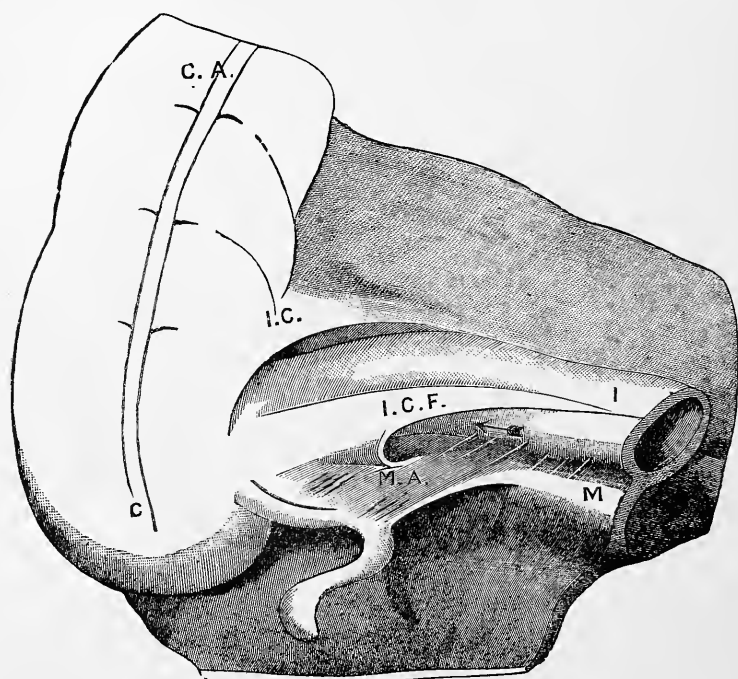
FIG. 175. (LOCKWOOD AND ROLLESTON.)

The Folds about the Cæcum.

C. Cæcum; C.A. Ascending Colon; I. Ileum; I.C. Ileo-colic Fold; I.C.F. Ileo-cæcal Fold;
M. Mesentery; M.A. Meso-appendix. The arrow marks the superior Ileo-cæcal Fossa.

the top of the appendix, but sometimes may be completely
absent when the appendix is free. In other cases the meso-
appendix is spread out over the cæcum, the cæcum opening up
and burrowing under its layers; or the mesentery may be so
spread out that the appendix is sessile on the iliac fossa. The

meso-appendix is frequently described as being too short for the appendix, causing it to become twisted ; in inflammation of the appendix this twisting would, from swelling, be exaggerated and thus favour occlusion.   When the appendix is sessile the occurrence of the retro-peritoneal phlegmon is rendered more likely.   If the mesentery is absent, the artery of the appendix
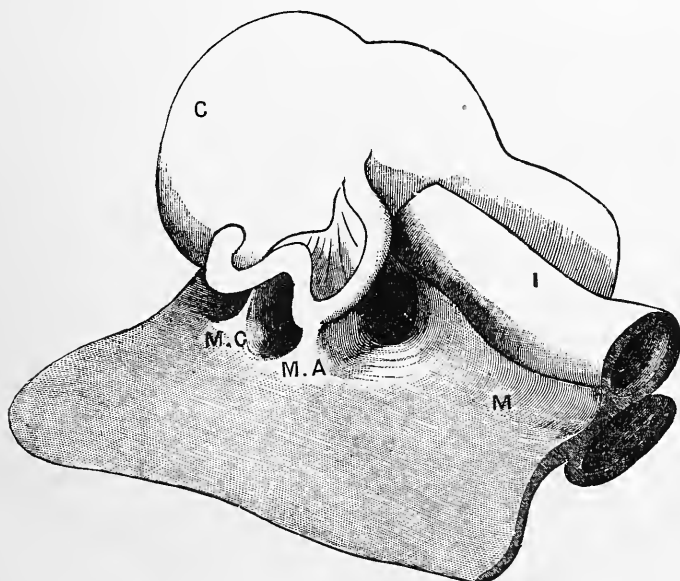
FIG. 176.   (LOCKWOOD AND ROLLESTON.)

The Superior and Inferior Ileo-cæcal Fossæ.

C. Cæcum ; I. Ileum ; M.A. Meso-appendix ; M.C. Meso-cæcum ; M. Mesentery.

lies under its peritoneum.   The lymphatics are gathered into a gland which lies at the junction of the appendix with the cæcum.

The minute structure of the appendix is essentially that of the cæcum with mucous, sub-mucous, muscular and peritoneal layers.   The mucosa is remarkable for containing in its meshes numerous and large aggregations of lymphatic tissue,

forming lymphoid follicles similar to those found in the tonsils. Sometimes these lie in the mucosa, causing bulging of it; usually, however, they lie in the sub-mucosa. These follicles are probably intimately concerned in the production of certain inflammations in the appendix which are ascribed to chill or exposure, or to conditions allied to rheumatism or gout. On the free surface, lying on its basement-membrane is the usual layer of columnar epithelium; it is always covered with numbers of microbes of several varieties, amongst which is always conspicuous the bacillus coli communis. In the sub-mucosa ramify the small vessels which supply the mucosa. The muscular layer consists of circular fibres entirely; it is comparatively thick, forming one-third of the general thickness. The fold or valve of Gerlach at the junction of the appendix with the cæcum is a simple duplication of mucous membrane extending half-way around the lumen and narrowing the orifice. It is more easily demonstrated on specimens that have been blown out and dried than on wet specimens. It has little surgical significance.

CAUSATION OF APPENDICITIS.

A consideration of the causation of appendicitis is beyond the limits of this work, and can only be briefly referred to. The literature as at present existing has not yet separated true causes from casual concomitants, or necessary effects. The sequence of cause and effect is indeed most difficult to arrange. To the operating surgeon rather than to the pathologist in the *post-mortem* room must we look for an elucidation of the true causation. The chain of causative sequence is, *post-mortem*, lost in a jumble of concomitants and effects, in the production of which many purely accidental conditions may have had a share, and the unravelling of which is often purely conjectural or impossible.

The causation may broadly be divided into *non-mechanical* and *mechanical*—the mechanical being by far the more important.

Of the *non-mechanical* causes—that is, where the lesion has

origin in some specific disease in the tissues of the appendix—the most important is of the nature of an adenitis, or ·inflammation of the abundant lymphoid tissue in the appendix. Of the existence of this variety of appendicitis I have no doubt; and that it has some connection with the uric acid diathesis on the one hand, and inflammations of the tonsils and other lymphoid tissues as met with in the young on the other, I am further convinced. I have no knowledge of its having required surgical treatment. Tuberculosis is found in the appendix, and so more rarely is actinomycosis. Typhoid ulcers also are found in the appendix and may cause perforation. No more need be said of this class.

In the *mechanical* causation of appendicitis, obstruction of the lumen is the prime factor. It may safely be affirmed that very few cases of appendicitis would become dangerous if there were a free passage always patent between it and the cæcum. If there were no secretion in the appendix to be passed into the cæcum this obstruction would be of no moment. Between slight and excessive secretion on the one hand, and incomplete and complete obstruction on the other, we have all degrees and stages, and on these may, roughly speaking, be built up the clinical varieties of appendicitis as we meet with them.

Assuming then that the presence of appendicular catarrh with obstruction to its flow into the cæcum is an almost essential element in the production of the disease, we may resolve this causation still further. And this naturally divides itself into (A) a consideration of the obstruction, and (B) a consideration of the catarrh.

A. *Obstruction of the lumen* of the appendix may be caused in various ways. Of these the most important are :

    I. From malposition of the appendix.

        (1) In external hernia.
        (2) In internal hernia.
        (3) In fixation by old adhesions.
        (4) In casual or developmental misplacements.

II. From Constriction of the Lumen.

(1) From causes residing in the appendicular walls: stenosis; local catarrh. [Cystic appendix.]

(2) From outside influences: kinking; torsion; traction from old adhesions; pressure outside.

B. *Catarrh of the appendix* may originate as follows:

I. From calculi.

(1) Foreign bodies swallowed.

(2) Fæcal concretions.

II. From putrefactive changes in the retained secretion.

III. From external traumatic influences causing irritation.

These causes thus isolated rarely act in isolation. Combinations of them in endless variety are met with. Some examination of their mode of action may help in the elucidation of their clinical development.

In *external hernia* of the appendix, alone or associated with hernia of the cæcum, we may expect to find some degree of appendicitis. In a case of radical cure on an inflamed femoral cæcal hernia, I found the appendix adherent by the apex to the sac and greatly thickened and inflamed. At one of our local medical meetings last year Mr. Green of Bath showed an appendix which had been perforated by pellets of shot as it lay in an old inguinal hernia.

Thurman[*] and Annandale have recorded similar cases. The rarity of hernia of the appendix, with the frequency of perforation when herniated, proves that hernia is a real cause of appendicitis.

In *internal hernia*, the careful studies of Berry[†] and Lockwood[‡] prove that we have here a real if rare cause of appendicitis. The variety of chief importance is that into the

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[*] Berry, "Pathology of Appendix Vermiformis," *Journal of Pathology*, April, 1895.

[†] *Loc. cit.*

[‡] *Trans. Path. Soc., Lond.*, 1890, xli., p. 119; and with Rolleston, *Journ. Anat. & Phys.*, 1892, xxvi.

retro-cæcal or secondary cæcal fossa. As strangulation in this position is not likely to be produced, the result is probably through kinking of the tube or in some other way producing obstruction to reflux.

Fixation by adhesions of an extrinsic nature, starting perhaps in typhoid or in any of the varieties of pelvic peritonitis, may by elongation or kinking, or otherwise, result in a narrowing of the tube. Such adhesions always dragging on the organ may further cause irritation and catarrh. A catarrhal appendix on the stretch is on the way to becoming generally inflamed.

Casual misplacements, too numerous and too varied for description, may cause appendicitis. I have removed an inflamed and hypertrophied appendix which lay immediately under the parietes in front of the cæcum, and could easily be palpated through the parietes as a long thickened cord. There were no adhesions ; it was blocked by the flexure. Similar examples have been recorded.

Constriction of the lumen of the appendix, a feature in all or nearly all, cases of surgical appendicitis, can rarely be a prime or solitary cause. Complete constriction produces a cystic appendix, or it may result in atrophy. Stenosis, congenital or resulting from ulceration, is rare. Catarrh, either alone or associated with lymphadenitis, does not often cause serious mischief. The chief troubles originate from outside influences, and are of the nature of kinking, or torsion, or traction, induced in many ways through the medium of inflammatory adhesions. Pressure from outside is a rare cause.

Foreign bodies have for a long time been associated with appendicitis ; they have even held the position of being considered the sole cause. Now we know that they are by no means the sole cause, but that they are contributive causes in a large proportion of cases is undoubted. What is their exact mode of action has been a source of discussion and disagreement.

Foreign bodies may be swallowed; or they may be calculi formed of various salts and mucus, or simply of hardened

fæces. The latter variety is the more common by far, but the former undoubtedly exists. Thus, in my own recent experience, pellets of chilled shot, two orange-pips lying side by side, and a date-stone found in cases of suppurative appendicitis are beyond the possibility of dispute. The reports of Fitz, Krafft, Matterstoek, and others (Hawkins) give the presence of fæcal concretions in from 34 to 53 per cent. in all cases, while true foreign bodies are found in only 12 per cent. This is in accordance with my own experience. About four times as many examples of fæcal concretions, so called, have been met with; and in half or thereabouts of all operations I have performed, or seen performed by colleagues, no foreign body has been found. This of course is no proof that it was not present.

Now, a foreign body swallowed and passed into the appendix is caught as in a trap. The appendicular muscle can pass a body towards its apex; we have no proof that it can pass it back into the cæcum. It can contract, and get "erect"; and any fluid present would, if there were an opening, be forced into the cæcum and with it the foreign body if it were small enough. But such contractions might be futile for expulsion; and each effort would by setting up catarrh make matters worse. This is probably the explanation of so-called appendicular colic. It is difficult to believe that it could be caused by the passing of a calculus into the appendix. Patency necessitates quiescence or at least absence of contraction of muscle.

Appendicular calculi which show concentric lamination, following the shape of the appendicular lumen, must as regards their chief bulk be formed in the appendix. But it is not certain that they all have their origin in the appendix, any more than it is certain that all urinary calculi have their origin in the urinary bladder, or all biliary calculi their origin in the gall-bladder. An appendicular calculus may form round a small fruit-stone (as I have found) or any of the innumerable solid particles which lie in the fæces. Semi-solid fæces in the appendix may have its liquid portions absorbed, and become hard or almost stony;

such calculi are quite amorphous. These calculi may remain quiescent in the appendix for uncertain and apparently indefinite periods. Something beyond their mere presence is necessary to set up mischief.

Influence of Micro-organisms.—This is, perhaps, the most important single factor in the development, not in the prime origin, of appendicitis. The researches of many men prove this beyond any doubt. Not only the bacillus coli communis, but a number of other putrefactive micro-organisms are always present in the large intestine, ready to multiply in favourable soil such as appendicular secretions ; and ready to enter opened areolar spaces, and to play their wonted havoc around and in veins and lymphatics. In all cases of suppurative appendicitis they are present ; it is indeed impossible to name a variety of appendicitis in which their influence has certainly been absent. Their influence will be further considered presently.

External traumatic influences may, by irritation or interference with the vascular return, set up appendicitis. Fixation of the tip of the appendix to a mobile organ is the most common example of this variety. I have found an example of this cause where an adhesion between the appendix and the right ovary existed. The example already quoted where the appendix was fixed by its tip to the fundus of a hernial sac is apposite. These cases do not often go on to cause suppuration.

PATHOLOGY OF APPENDICITIS.

Varied as is the causation, the pathological progress of a case of appendicitis is, within certain limits, fairly constant.

A natural and generally accepted division has been made into " catarrhal " and " ulcerative " appendicitis ; a third division being sometimes added—" infective." Fowler makes a division, according to the coats invaded, into Endo-appendicitis, Parietal Appendicitis, Peri-appendicitis, and Para-appendicitis. Such divisions may properly be regarded as stages in the one continuous progress of the disease : an arrest of the progress at any one stage thus constitutes a

separate variety. I am doubtful whether the " infective " variety should be an independent one : it is probable that micro-organisms play an important part in the progress of all the varieties.

Catarrhal Appendicitis. Endo - Appendicitis.—This is of the nature of catarrh of mucous membranes everywhere. There is proliferation and shedding of epithelial cells, infiltration of leucocytes in the areolar tissues and excessive secretion of fluid. There is probably obstruction to the outflow; the appendix is distended ; contractions of the circular muscle take place, producing appendicular colic. The condition may result in the formation of a fibrinous clot, which may shrivel and be followed by obliteration of the lumen ; or it may remain as a chronic retention cyst: a hydrops appendicis may remain in a chronic form with remissions and relapses, or it may go on to ulceration or even to necrosis of the whole appendix.

Ulcerative Appendicitis. Parietal Appendicitis.—Whether true ulceration can take place without preliminary catarrh or not is doubtful. Hawkins limits this variety to that which is not preceded by a general catarrh, and is due to the presence of a fæcal concretion or foreign body. There is no doubt that the presence of a fæcal concretion may predispose to, and determine the position of, ulceration; but I think it is doubtful if the mere passive presence of a foreign body—except sharp-pointed ones, such as pins and fish-bones—often causes ulceration. A combination of catarrh and appendicular contractions, set up by and aggravated by the foreign body, is probably in most cases the true cause of ulceration.

When the mucous membrane is destroyed, progressive necrosis, aided no doubt by invading micro-organisms, goes on through one coat after the other until perforation takes place. If the progress of ulceration is towards the peritoneum, a protective peritonitis is set up, a heaping up of phagocytes in front of the invading micro-organisms, which may for longer or shorter periods prevent ulceration into the peritoneal cavity. When

the areolar tissues are opened up to the ulcerative process, septic phlebitis, arteritis, and lymphangitis are liable to be set up and to spread along surrounding areolar tissues, and to produce septic cellulitis which may become widely distributed. Inflammation of the iliac vein with thrombosis and œdema ; gangrene of the walls of the iliac vessels, and hæmorrhage resulting fatally ; hepatic abscess from the conveyance of septic emboli through the portal circulation, are amongst the outlying results arising through invasion of the vessels. As a direct local result of vascular thrombosis, gangrene of the whole appendix is not infrequent. Should it happen that the opening takes place into the mesentery of the appendix, or into the areolar tissue under a sessile appendix, a wide-spreading extra-peritoneal cellulitis is set up which may burrow downwards into the pelvis or upwards to any extent under the ascending colon, kidney, liver, and diaphragm, or even into the kidney.

The most important single outcome of appendicitis is the production of *peritonitis.* In at least half of the cases the ultimate reason for surgical interference is the occurrence of peritonitis. From a surgical and clinical point of view, I had in the fourth edition of this work divided the varieties of appendicitis into (1) Perforative, (2), Purulent, and (3) Plastic : this corresponds with Hawkins' division of the varieties of peritonitis into (1) Acute general, (2) Local suppurative, and (3) Local adhesive. An elaborate study of the whole process of peritonitis following disease of the appendix is provided in Hawkins' work.

General peritonitis results from perforation of the appendix and escape of its fæcal and infected contents into the general peritoneal cavity. In the majority of such cases a concretion is found ; a cystic appendix with constriction is rarely found. With the local necrosis which permits escape of the appendicular contents is usually associated violent inflammation of all its parts. From the rapidity with which the peritonitis spreads, such cases have well been named "fulminating." That the inflammation is bacterial in its main effects may now be regarded as certain. Bacillus coli communis is most commonly

present : after it comes various streptococci ; staphylococci are comparatively rare.

Local suppurative peritonitis is the old perityphlitic abscess. Here there has been protective peritonitis : an artificial sac of inflammatory material has been formed round the perforation, thus limiting the diffusion of septic material and resulting usually in the production of pus. The walls of such a sac may primarily be formed of appendicular peritoneum alone, but the peritoneum covering the neighbouring parts, intestines and parietes, soon become involved and agglutinated. As suppuration progresses the pus finds new outlets, and burrowing or forcing its way between the bowels, forms new collections or abscesses communicating with the first. Occasionally a single large abscess is found. In one case I found the walls of a single large abscess in a state of complete necrosis : the parietal peritoneum came away in sloughs. Here the appendix was sloughed, but not perforated, and contained a foreign body. The patient died. We may find one small abscess or one large one ; a multitude of small burrowing collections or two or three abscesses of moderate size.

Local adhesive peritonitis is usually a result of simple catarrh, and is rarely associated with ulceration. It may, however, be associated with perforation. The appendicular peritoneum is thickened, and probably glued to thickened intestinal or parietal peritoneum. The amount of thickening may be slight ; in some cases, however, it is enormous. In one case where the thickening caused a visible and palpable tumour in the loin, I found a minute perforation, around which lay about a teaspoonful of glairy mucus, evidently secreted by the appendix. The cause of the perforation was not found. A cystic condition of the appendix has so often been found associated with this variety of peritonitis, that I believe occlusion of the lumen, preventing ingress of fæcal matter, as well as egress of appendicular secretion, has an important influence on its causation. Rupture of a cystic appendix from over-distension, as distinguished from necrotic perforation with inflammation, might account for the condition. The fluid trickles out of the

rent in drops, and the peritoneal cells by a process of phagocytosis are competent to deal with them.

SYMPTOMS AND DIAGNOSIS.

The symptomatology, so far as surgery is concerned, is best grouped according to the later developments of the disease, those associated with peritonitis. Surgical interference is, in fact, rarely called for till peritonitis has appeared. The clinical signs may be made to tally with the pathological varieties, and the symptoms are given as for the Perforative, the Purulent, and the Plastic varieties. A sub-variety of the Plastic is known as " Relapsing or Recurrent."

Perforative or Fulminating Appendicitis with General Peritonitis.— In this the most fatal form of the disease there are either no premonitory symptoms whatever, or such symptoms are of short duration and of uncertain import. The first real sign of the disease is severe pains in the abdomen, rapidly followed by collapse and other signs of diffuse peritonitis. The abdomen becomes rapidly distended, vomiting sets in and continues ; thoracic movements become embarrassed, the skin becomes dusky, the eyes sunken, the pulse very rapid and flickering. In these cases the pain is rarely located in the right iliac fossa ; it radiates all over the abdomen, and is usually worst at or near the umbilicus. Occasionally there is diarrhœal incontinence of fæces, usually there is no passage of either flatus or fæces. The temperature may be raised a little at the outset, but it soon falls to normal or subnormal, and remains low till a few hours before death when it may rise as high as 103° or 106° Fah. The patient struggles for breath, sometimes becoming violent but rarely delirious. Often his mind is clear to the last.

I have never known a case of true fulminating appendicular perforation recover. Of the few cases of recorded recovery at least one-third ought to be placed in the category of diffusion of peri-appendicular abscess ; another third were not

truly general ; and in the remaining third slow onset of symptoms proved slow extravasation rather than sudden diffusion. In my experience, no other perforation of hollow viscera is to be compared in the virulence of its sequences with sudden appendicular perforation. The patient seems doomed almost from the hour of the accident.

This variety supplies only a small proportion of all the cases.

Purulent Appendicitis. Peri-Appendicular Abscess.—The formation of abscess is often associated with a previous history of trouble in the right iliac fossa. A strain, an injury, an indigestible meal, are sometimes quoted as the origin of the disease ; these can scarcely act as other than contributing to a train of causation already laid. It is, however, impossible to ignore the frequency of such histories. In some cases the onset is sudden ; in others it is gradual. The patient may have complained for a few days or perhaps weeks of vague fleeting pains in the right iliac region ; he may have continued getting about or even doing his work, and may have exhibited few symptoms of illness beyond constipation or dyspepsia or other intestinal disturbance. In others the symptoms are more marked : they are obliged to stay in bed ; the appetite is capricious ; the tongue gets foul ; there is a little elevation of temperature at night, and occasionally a rigor with sudden access of fever. There may be a worrying diarrhœa with little evacuation, or absolute constipation. Suddenly these symptoms may become aggravated, indicating extension or diffusion of the abscess, and the symptoms then become those of general peritonitis. Or the signs of spreading may be more slow and deliberate with repeated rigors, aggravations of pain, and extension of the local signs.

The local signs are here of great importance. They are subjective, relating to pain in the right iliac fossa, aggravated by pressure over a certain spot ; and objective, discovered as swelling and induration by palpation through the parietes and the rectum, and by percussion.

A subjective symptom of importance is the discovery of a specially tender spot by pressure with the tip of the finger at a point half-way between the umbilicus and the anterior superior spine of the ilium. This was first described by McBurney, and the area has since been known as " McBurney's Spot." It lies directly over the base of the appendix. Occasionally pain shoots down the thigh in the course of the anterior crural nerve ; frequently it radiates upwards and inwards.

Objective signs relating both to peritonitic thickening and to abscess formation are revealed by palpation and percussion. Palpation in most cases of peri-appendicular abscess will reveal thickening somewhere in the right iliac region, either as a round, smooth, globular mass, or as a general diffused induration. The region of thickening varies according to the seat of perforation and the position of the appendix. Sometimes it fills the costo-iliac space, extending between the iliac crest and the lower costal margins. Occasionally it scarcely rises above the crest, rarely it has its chief bulk between umbilicus and ilium. By the rectum a large abscess may often be felt near to the sacro-iliac synchondrosis ; and a retro-peritoneal cellulitis extending into the pelvis may always thus be felt. General matting may in children especially be diagnosed by rectal examination.

Percussion over the thickened area gives either a modified dull note or resonance ; rarely absolute dulness. The thickening which is felt is usually caused by an agglutinated mass of bowels, and percussion of this does not give dulness. An appendicular abscess, even when in contact with the parietes, is nearly always resonant on percussion because it contains gas, which of course rises to the surface. Advance of the disease may be attended with amelioration of the physical signs. There may be diarrhœa—this carries off quantities of gas and causes flattening of the abdomen. A secondary abscess may form, carrying off part of the contents of the first, and leaving it collapsed and soft. As gas is excreted dulness disappears. All these may combine to mislead us

as to the progress of the case. These facts have been impressed upon others as well as myself in actual experience—once a very painful experience—and ought to be strongly insisted upon.

There is no certain proof of the formation of pus ; no single symptom or aggregation of symptoms prove its presence. Temperature is no proof; the worst cases of suppuration may have subnormal temperature, and continued elevation of temperature may be associated with simple plastic appendicitis. An aggregation of the leading signs and symptoms related renders probable pus formation, but they do not certainly prove it. It has been said that the diagnosis of pus formation must rest rather on an increase or aggravation of symptoms than on any specific peculiarity or grouping of the symptoms. This is to some extent true ; but there is, from the beginning, one aspect to the cases which are suppurative and another to those which are simply catarrhal or plastic. In the latter, pain and pyrexia and general disturbance may be severe, but the patient never 'has an aspect of dangerous illness ; in the former, even though there is little pain or fever, it is clear that the patient is seriously ill. There are many exceptions to this statement, but taken broadly it is true enough to have some weight.

Simple Appendicitis—Plastic or Catarrhal.—It is in this form that appendicitis is most frequently met with, and in this sense it may be regarded as the most important. Frequently the history of previous, less severe attacks is elicited, and in not a few cases the cause is set down to partaking largely of indigestible food. Intestinal worry or increased peristalsis or muscular strain, too frequent precursors to be summarily dismissed from the position of causation, must act rather as setting in action a train already laid, than as originating the disease. In the majority of cases, however, the attack is sudden and no cause can be given for it.

Pain is the first symptom complained of. In an equal proportion of cases this pain is spread all over the abdomen

or located in the right iliac fossa. If the pain is at first diffused it tends, later on, to become localised and to continue settled over the seat of the disease through its progress. The pain in character is griping or colicky and varies in intensity. Sometimes it is so acute as to make the patient cry out, in other cases it is not so severe as to make him cease from work. The first onset of pain is frequently followed by an attack of vomiting, but this rarely persists. Constipation is usually present, and many of the cases will have had a purge administered before medical assistance is sought.

Tenderness on pressure, most marked at McBurney's point, midway between the umbilicus and the anterior iliac spine, is an almost constant symptom. This symptom is of most value in the earlier stages before inflammation has become diffused. Examination per rectum may in children or small adults reveal an actual thickening near the cæcum; bi-manually pressure between parietes and rectum may be more effective in discovering thickening than simple pressure from either way. Edebohls points out that firm pressure through the parietes along the pelvic brim may succeed in palpation of the appendix and give valuable information as to its position and state. Such pressure however could scarcely be borne by a patient with appendicitis, and the records of cases of abscesses being diffused after examination warn us against any use of force in palpating for diagnosis.

Some elevation of temperature (100°—102°) may be expected after twelve or twenty-four hours; and this continues, usually with a fall in the morning, during the persistence of the attack. The temperature may be elevated for periods varying between one or two days to six weeks, as in a case of my own, where at operation there was no pus.

Abdominal distension is not a marked feature; but abdominal rigidity from contraction of muscle is always present, and is most striking over the right side. This rigidity rarely lasts more than a day or two; as it passes off, an inflammatory mass usually becomes palpable amongst the bowels in the diseased area. This inflammatory tumour

varies much in size, position and outline.   Occasionally no
tumour is felt at all: sometimes it is the size of a hen's egg;
most often it is about the size of the clenched fist.   In position
it may be almost anywhere in the right iliac fossa; usually
it lies just clear of the iliac crest, directly over its anterior
third.   But it often fills the flank, and occasionally gets as far
forward and downward as to be in contact with the outer third
of Poupart's ligament.   Its outlines are usually somewhat
vague, but sometimes they are as clearly defined to palpation
almost as a cricket-ball.   The tumour rarely causes bulging; but
I have operated on two cases where the inflammatory swelling
made quite a marked swelling in the costo-iliac space.   Where
the swelling is of any great size it is usually possible by
bimanual palpation to detect it by the rectum.

It has already been remarked that there may be no tumour,
palpable or actual.   In such cases there is either little or
no peritonitic thickening, and such cases are asually simply
catarrhal and interstitial.   One hospital case on which I
operated had an appendix as thick as the forefinger and almost
as hard, lying directly under the parietes and easily palpable
there, in which there was much thickening, but no adhesions
or surrounding peritonitis.   He had had four previous attacks.
I have seen a somewhat similar case in the practice of a
colleague.

As a rule the acuteness of the attack diminishes in about
a week; and, gradually diminishing, it is over in about a
fortnight.   The thickening, if present, lasts much longer, and
may not have disappeared in two or three months.   Frequently
the attack recurs, often before the thickening disappears; and
this has been classified as a separate variety—Relapsing or
Recurrent Appendicitis.

Relapsing or Recurrent Appendicitis.—This is to be regarded, not
as a separate variety, but simply as recurrence in an ordinary
non-suppurative appendicitis.   It is doubtful if a case with
formation of pus ever gets sufficiently well to be called relapsing.
Most of such cases have not perforated; and if there is per-

foration there is escape only of mucus from the appendix itself, there is no communication with the cæcum. But each relapse renders more likely the formation of pus, for it is almost certain that pyogenic organisms are present in the exudate.

The symptoms of a relapsing appendicitis are sufficiently indicated in the name. There is recovery from one attack, a period of immunity varying in length from a week to months or even years, then a renewal of the attack. In some cases the severity of the attacks diminishes; in some they increase; in some they are attacks of greater and of less severity. I have operated on one patient who had at least thirty attacks in three years, of different degrees of severity, but on the whole on the increase. A medical friend has had six attacks in two years, each attended with the formation of a large tumour; the later attacks have been at longer intervals, but have been more severe. There is, as we might expect from our knowledge of the pathology, no law as to frequency or severity of these attacks, and no prognosis as to recurrence is possible. One patient, who had four severe attacks, after deciding on operation, changed his mind and has not, after two years, had another. Another after four attacks, each diminishing in severity, was advised to have no operation; he suddenly had suppuration and just escaped with his life after operation. I am fully convinced that, with the clinical facts available, prognosis is impossible in recurrent appendicitis. From one attack a year to one attack a month, examples have been quoted.

It is unnecessary to recapitulate the special symptoms. They are simply those of ordinary plastic non-suppurative appendicitis repeated at each attack.

Appreciation of Operation. Mortality. Indications for Operation.—Appendicitis presents itself in such a variety of aspects and under conditions of such different degrees of danger to the patient, that a general consideration of mortality statistics is of little value. Thus one patient rescued from certain death after an attack of fulminating appendicitis, amongst twenty

that have died after ¡operation, is as good surgery as nineteen saved out of twenty operations for relapsing appendicitis. The risk to be run is to be measured against the danger to be avoided. Most cases of appendicitis cause little danger to life; in these operation should have a very low death-rate. A few cases untreated by operation will certainly be fatal; here a very high death-rate would still justify operation. Cases of fulminating appendicitis are nearly always fatal whatever is done; still, a few operative recoveries have been recorded, and these justify operation.

The most complete statistics with which I am acquainted are those of Porter*. He collects 448 operations with a general death-rate of 17.23 per cent. Of these 151 had removal of the appendix carried out during the attack, the mortality being 19.7 per cent.; 14 had removal during quiescence, with 14 per cent. mortality. Simple incision and drainage was carried out in 188 cases; here the mortality was 18.18 per cent. In 95 cases no operation was performed, and a death-rate of 13.68 followed. These statistics do not include many cases hitherto unpublished, my own for instance. I have lost 4 out of 22 operations; two being cases of general diffusion through the peritoneum, one associated with diffuse peritoneal gangrene, and one with diffusion of a large abscess.

Richardson † gives the results of his extensive personal experience as follows. Of chronic cases he had 15 operations, all recovering. Of acute cases, 58 operations, with 30 deaths. Of recurrent cases, 4 operations and no deaths.

It will thus be seen that operation in appendicitis is for some varieties of the disease a grave proceeding, for others safe and satisfactory. For one class of cases, the sudden perforating or fulminating variety, neither physician nor surgeon can be held responsibe; the patient is almost instantaneously placed in most imminent danger, from which operation can scarcely rescue him. For another class, the slow suppurating variety, risk is increased by delay, and this delay is sometimes permitted through timidity in treatment or

* *Amer. Journ. Med. Sc.*, 1893, cvi.   † *Amer. Journ. Med. Sc.*, 1894, cvii.

uncertainty in diagnosis. A death-rate, through delay, of something near 20 per cent. certainly demands urgent consideration as to whether any doubtful case should ever be left untreated. In America most surgeons are clear and outspoken in their belief that appendices should be removed, even on suspicion. In England more caution holds; but it is doubtful whether true wisdom and real caution do not abide with the bolder policy.

The indications for operation are strongest where the mortality is highest—in cases, that is, with sudden perforation and with formation of abscess. Operation in the former class gives the patient the only chance of life—a small one, it is true, but as being the only chance, worth risking.

In every case of suppuration operation is indicated. There is no exception to this rule. Recoveries after absorption of pus are so problematical, and after bursting of the abscess through parietes or bowel are so rare, that they must in practice be ignored. And further, the probability of the formation of pus, even the possibility of it, ought, in the face of the inevitable risks, to be looked upon as justifying operation. Many surgeons (and I am one of them) consider that we ought to operate even on the suspicion of suppuration.

In the case of the simple and relapsing forms of appendicitis the question of operation may properly be discussed for every case, almost for every attack. The risk to life in these cases from suppuration or from perforation is small, although it is present. Most often, therefore, the question is one of disablement and the amount of it. I think also that the amount of peritonitic thickening should be taken into account: the least risk is run in those cases where there is most thickening, and the greatest where there is no protective thickening. The call to operate in recurrent cases is, in my opinion, most urgent where physical signs in the way of inflammatory tumour are absent.

The natural death-rate of all cases of appendicitis treated by methods other than surgical is about 14 per cent., and the deaths are all of them in cases of perforation or abscess forma-

tion. Simple perityphlitis or non-perforating appendicitis has practically no death-rate. Now, it has been argued from this that no simple case ought to be operated upon. It is forgotten that many of these cases, apparently originally simple, become suppurative or even perforating; and the death that is recorded is then not put down to neglect of a simple case, but to the progress of a suppurative one. On the other hand, a simple case lost by operation has no credit given to it as possibly saving from later death by perforation, while discredit is thrown on the mortality from operation as against the mortality from medical treatment. Figures here do not help us at all; it is useless to quote them.

Now, the surgeon confronted with an ordinary case of appendicitis knows the chances are somewhere between 3 to 1 (Hawkins) and 5 to 2 against his having any subsequent attack. Should he have any subsequent attack, the chances against its killing him are as 7 to 1. In other words, a second attack of appendicitis is more dangerous than an attack of enteric fever. As to recurrence, if the risk of a second attack is as high as one-third, the chances of a third, fourth, or fifth attack after the second are much greater. What amount of illness or disablement the patient may suffer in addition to the risk we cannot foretell; operation saves him from dangers which can never be estimated.

It is impossible to be definite, and it would be wrong to be dogmatic. To lay down rules as to operation on the first, second, or third day is to override the values of such facts and figures as are available. There might be some reason, on the one hand, in operating on every case of appendicitis the moment it is diagnosed; and on the other, in refusing operation till pus has formed. But rules for any sort of compromise are useless.

The case must be left to the judgment of the surgeon. A case with no discoverable causation which seems severe from the outset would be selected for operation. One, again, which comes on after a chill or an attack of indigestion, and where the severity is not great, might be let alone, and carefully watched. In the relapsing forms the frequency of the attacks

and their severity must broadly guide us. The judgment of the surgeon and the desires of the patient must here be the guides. One patient may desire operation after his third mild attack, when another prefers to go on suffering from them, hoping that they may disappear. Another, after a sharp attack which has endangered his life, may elect to have his appendix removed. This is, indeed, one of those operations wherein the patient may, with perfect propriety, be permitted to have some influence on the decision of the surgeon.

In these relapsing cases Treves introduced the method of operating during quiescence, in the interval between two attacks; and most surgeons, myself amongst the number, have followed his advice. The operation is done when the patient is free of fever, when the abdomen is not distended and the bowels are empty. Whether the operation is surgically easier as regards the local condition is doubtful. It is possible that when the adhesions become organised isolation of the appendix may be more difficult.

OPERATION FOR APPENDICITIS.

The operative details will vary according to the variety of appendicitis to be dealt with: it will perhaps conduce to clearness if separate descriptions are given as for a typical example of each variety—the Perforative with diffusion; the Suppurative with abscess; and the Plastic with adhesions.

The patient is prepared as for other abdominal operations. If there is profound shock, a preliminary rectal injection of brandy will be administered. Some surgeons employ the Trendelenberg posture in simple cases: in cases of suppuration any unusual or strained position might facilitate rupture; and in cases of septic contamination this posture would permit fluids to gravitate in the most dangerous direction, towards the diaphragm. The ordinary supine position is usually employed.

The *Parietal Incision* on operations for appendicitis demands some consideration. It has been proved too abundantly that an incision which divides all the muscles and through which drainage is carried out will probably result in ventral hernia.

Therefore attention ought to be paid to methods whereby muscles or fasciæ are preserved. Difficulties have arisen from a making of the incision too far away from the seat of disease; therefore a site should be selected which will for the given case provide easy access to the organ. Further, deaths have resulted from the diffusion of putrid fluids into the peritoneum, resulting from an incision which traverses the general cavity. In every case these considerations should as far as possible be met and overcome.

As regards the site of the incision, in cases without tumour or abscess the middle of it may well be at McBurney's point, half-way between anterior iliac spine and umbilicus. This overlies the appendix. If it is carried a little further back the distance will be a little shortened. A vertical incision carried through this point will cause division of all the muscular layers —and some portion, probably, of the aponeurosis of the external oblique. To avoid this, on the grounds already discussed, the best line of incision is probably to follow the direction of the fibres of the external oblique, upwards and backwards. A small incision is first made down to the aponeurosis or the muscle, or, as often happens, to the junction of the two; this shows the direction of the fibres. The incision is prolonged upwards and downwards in the direction of the fibres for a total length of about three inches, more or less according to the thickness of the parietes. The fibres of the internal oblique are seen on separation of those of the external oblique. The forefinger is pushed through them and separates the bundles upwards and downwards. The surgeon will then see whether it is possible, without hampering the proceedings, to finish the operation without any division of this important muscle. Separation of fibres of internal oblique is the easier the further back the incision is carried, for then they are more vertical. If some division is made it should be only for half the extent of the wound, and somewhat obliquely to the first incision, so that some of the resulting weakness may lie behind undivided parietes. The transversalis is not very bulky here, and its integrity as regards hernia is not very important; while if it is

not cut it hampers freedom of access, lying at the bottom of the wound. If the external oblique and its aponeurosis are intact and the internal oblique is spared as much as possible, we have done as much as we need to spare the patient further trouble. In many cases, especially in children and in patients with thin parietes, entrance may be made without division of a single fibre. The forefinger should always replace the scalpel as far as possible in these cases. The wound may, if necessary, be kept open by retractors : but these are rarely called for. The intra-abdominal manipulations are mostly carried out by touch ; and the first and second fingers of the left hand retract for themselves. If the parietes are thick and the muscles not paralysed, retractors will save finger-strain. If an abscess has to be mopped out and the appendix removed and ligated at the bottom of it, retractors of some sort should always be employed.

If there is a visible or palpable tumour, the incision should be made with its centre directly over it. If the tumour lies far back the incision should be vertical, for then it follows the direction of the fibres of the internal oblique, here more important than those of the external oblique ; and if it follows the fibres of the external muscle it would get too far back before it was long enough. And towards the outside of such a tumour where the colon lies we are less likely to have to traverse many coils of adherent bowels, than towards the inside where coils of small intestine are aggregated. If there is an abscess at the bottom of such a collection, there is some advantage in having the drainage tube not vertical but as nearly horizontal as may be. Dependant drainage requires a second incision in the loin behind.

Where there is a large abscess the incision should always be over it, and well clear of any lines of inflammatory thickening which may surround it. On no account should the abscess be opened through healthy peritoneum ; the life of the patient may depend on the leaving undisturbed of all protective adhesions. The probable position of the appendix should influence the surgeon in keeping his incision over it, in the hope of removing

it ; but the main point is evacuation and drainage, and this is best done through the centre of the collection. As has been already pointed out, the centre of such an abscess is often at operation resonant from the presence of gas; usually at an earlier period it will have been dull on percussion. A ring of induration often surrounds the purulent collection and guides the surgeon to the seat of incision.

In closing the incision regard must first be paid to the tolerance of the patient, then to the prevention of hernia and the provision of drainage. Any divided muscle or fibre should, if possible, be united by a buried suture or by a suitably-placed gut suture, which is left in for some weeks. The drainage-tube may be carried between undivided muscular bundles at one or other end of the wound, and the divided muscle united by suture. But if the patient is very ill, time must not be wasted to the risking of life. · The weakened parietes had better be strengthened later on when the patient can bear it, than life be endangered by superfine surgery at the life-saving operation.

Operation in Perforation with Diffuse Peritonitis.—Here we have to deal with a condition of generalised septic peritonitis and a patient seriously ill or in a condition of profound collapse. The typical condition is where there are no adhesions and no abscess. But a similar, though at first less grave, condition may be caused by the sudden diffusion of a previously circumscribed abscess. The surgical measures are essentially the same for both conditions: to cleanse the cavity as completely as possible and to cut off the source of future infection. It is true that the results of peritoneal cleansing in these cases are very disheartening ; so much so, that justifiable criticism might be made as to the wisdom of the process. But it seems the only thing to do. A powerful poison is lying in contact with an absorbing surface; to remove it by irrigation is the first evident indication.

The *Parietal Incision* may in this case be made almost any-where, so far as the cleansing is concerned; but it is best made over the appendix, in so far as removal of the organ is concerned.

The ordinary oblique incision midway between the umbilicus and the iliac spine may be made along the fibres of the external oblique. The fibres of the internal oblique may be separated, or partly divided and partly separated. The peritoneum is picked up by, and divided between, catch-forceps in the ordinary way. The peritoneum in these cases is usually of a dusky-red hue.

Two fingers are at once carried down to the appendix, which may be found lying quite free in the cavity, or in the centre of a collapsed abscess sac. A forceps is placed on it and it is pulled to the surface, outside the incision if this is possible. Then irrigation is started, before the appendix is dealt with, and is continued during our treatment of the appendix. The best fluid for irrigation is, in my belief, a solution of Barff's boro-glyceride, of the strength of half-an-ounce to the pint; and the temperature of the fluid should be about 105° Fah., or a degree or two higher. The fluid is best introduced through half-a-dozen or more celluloid catheters placed in different parts of the abdomen, and all fed from the same irrigating rubber tube. They may be pulled through slits near the end of the large rubber tube, the end being tied. The irrigating reservoir should be about three feet above the patient. While the whole cavity is thus being washed out at different points, the fluid is permitted to escape and to run over the macintosh sheeting into a suitably placed receptacle below.

Meanwhile the appendix is being removed. Many different methods of removal have been employed, all of them being about equally successful. In these cases adhesions are usually either absent or not strong. In cases of rupture of abscess, however, adhesions may be very strong and very abundant. In this case the surgeon must exercise his judgment as to whether the appendix need be removed at all; for it has been found safer not to overdo operation, but to leave the appendix alone where it is firmly imbedded in adhesions. Usually matters right themselves with the help of drainage; if not, the worst that can be apprehended is a fæcal fistula, which may be dealt with more safely later on.

Simple deligation and amputation beyond the ligature, without any further treatment than curetting out the foul mucous membrane in the stump, is quite satisfactory in its results. Theoretically, we might expect trouble to arise from the exposed stump, or from the leaving of a small potential abscess sac between the ligature and the narrowed or obliterated opening into the cæcum; but, practically, no such evils have arisen. If the appendix is completely necrosed it may be unwise to place a ligature round it, but to aim at turning the stump inside the cæcum. Before amputation it is either tied or caught in forceps, so that fluids cannot escape into the cavity. The end of the stump is then gathered together in a continuous Dupuytren's suture and the forceps removed. Then two or three Lembert sutures are inserted through the sero-muscular coats of the cæcum by the sides of the appendix, so as to bring the cæcal walls together over the inverted stump. While the stump is being inverted the Lembert sutures are pulled tight and tied.
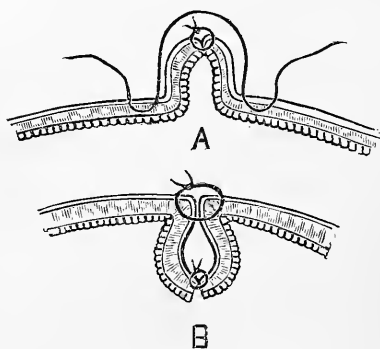
FIG. 177.

Diagrams to show method of Invaginating the Appendix into the Cæcum.

A. Appendix closed; involuting suture placed in wall of cæcum.
B. Appendix turned in; suture tied.

This process of invagination takes some little time; and if the patient is very ill and the stump fairly healthy, simple deligation close to the cæcum would be adopted instead. More elaborate methods of closure adopted in simple cases are not suitable in these cases with diffuse peritonitis. It is necessary to turn inside a gangrenous stump: this should always be done. No more than the necessary should be done, and so a stump which is fairly healthy should be treated by the simplest possible method—ligation and amputation beyond the ligature.

While the appendix is being dealt with irrigation has been

going on continuously, the fluids running over the macintosh into the reservoir provided. The position of the irrigating tubes may be changed, and the bowels moved about a little now and then as the operation proceeds. The duration of the irrigation must be measured by the tolerance of the patient. Occasionally the patient's condition improves during irrigation, then it may be continued for twenty minutes or half-an-hour ; rarely does the patient bear prolonged irrigation well. If adhesions are present, the cleansing process is made more difficult and less satisfactory. To break down the adhesions adds to the shock ; not to break them down makes irrigation imperfect. The use of several irrigating tubes gets most out of the process in a given time ; but no process of irrigation can be expected to cleanse the abdomen in the few moments which can be devoted to it. If it is possible to treat these cases with a continuously flooded abdomen, a distinct advantage is gained ; but the increase of abdominal pressure from distension of bowels soon forces out all fluid. The satisfactory cleansing of a peritoneal cavity whose surfaces everywhere have been contaminated with fæcal and septic exudate is, indeed, one of the most difficult tasks in all surgery.

Drainage should always be employed in these cases. At least three large perforated rubber tubes should be employed : one traversing the seat of disease and dipping into the pelvis, and one going well up into each lumbar hollow. If the patient keeps his ground, additional irrigation may be carried out through these tubes by means of a catheter after a few hours. The lumbar tubes may be removed after twenty-four or forty-eight hours ; the iliac and pelvic tube may remain in for three or four days.

From the very beginning the patient should be supported by stimulating rectal enemas. If he can take it, liquid and stimulating nourishment by the mouth should be given in moderate amount.

Operation in Purulent Appendicitis or Appendicular Abscess.—Here the prime object of operation is to evacuate an abscess, or localised

collection of pus, without contaminating the general peritoneal cavity. A further, but not essential, object is to remove the cause of the suppuration with the appendix. We may have to deal with encysted intra-peritoneal abscess, single or multiple, but all communicating with each other and the diseased appendix; or we may have to deal with one large retro-peritoneal collection, through which the appendix may not be felt at all.

The *Parietal Incision* in such cases should be made in such a position that access to the collection of pus may be secured without entering the cavity. If the swelling is in contact with the parietes at any part, the centre of this swelling should be the centre of the incision. If the collection lies low at some distance from the anterior parietes, the incision should lie to its outer side, because here the coils of bowels are fewest and the cæcum is more accessible. In many cases, especially those of extra-peritoneal nature, the incision may best be made at some distance away from the appendix. A ring of thickening surrounding an area of resonance indicates usually the limits of an abscess containing gas as well as pus; the opening should be made in the centre of the ring.

It will thus be seen that no fixed rules can be laid down as to the seat of incision in peri-appendicular suppuration, but that the surgeon must be guided by clinical signs and well-balanced judgment. In every case, however, the direction of the incision should follow the lines laid down as most likely to avoid the occurrence of ventral hernia. These have already been fully discussed and need not further be dwelt upon.

Entrance is made by separation of muscular fibres as far as possible with as little cutting as may be. If the sub-peritoneal areolar tissues are hard and œdematous, and this matting spreads through the muscular strata, the practice of division and of separation of fibres need not be carried far. In some of these cases it is possible, without using force, to wriggle the forefinger right into the abscess cavity: the only real obstruction is the peritoneum, and this is sometimes very friable. There is an unmistakable and characteristic feeling of hard

inelastic peritoneum overlying a collection of pus : it cannot be pulled to the surface to be incised; it is best divided by a combination of scratching with the finger-nail and pushing with the finger-tip. In most cases entrance will be made in the ordinary way by division of peritoneum pulled out between catch-forceps.

Pus, often of a very putrid nature, will in most cases at once appear in the wound. Before the pus is evacuated and the abscess is collapsed the forefinger is inserted, plugging the opening, and an examination made of its walls and surroundings. The presence of secondary abscesses is thus made out, and the situation of the openings that lead to them. Into these openings tubes are at once inserted, and the whole collection of pus permitted to run away. Adhesions are left undisturbed as far as possible, but efficient drainage for every subsidiary collection must be provided. The existence of secondary collections in the pelvis may have been diagnosed by rectal or vaginal palpation ; their emptying should be assured by examination before the operation is finished.

Cleansing the abscess cavity by irrigation, or sponging or mopping, is a proceeding for which a good deal for and against may be said. To wash out septic contents is not to purify an abscess ; the micro-organisms still remain in the abscess wall. To remove these scraping and irrigation by some such means as Barker's scoop are required, and this is quite inadmissible in an abscess whose walls are intestines. To mop up the putrid fluids by sponge applied to the abscess-walls is perhaps attended with less risk of diffusion than irrigation, but it can scarcely give more thorough cleansing. It must be admitted that we cannot render aseptic a putrid appendicular abscess ; that it must be drained ; and that nature, properly assisted, will provide the cure. It is waste of time and addition to risk to take much trouble over the washing out of an abscess and the purification of its walls. If efficient drainage is made to follow removal of the coarse contents of the abscess, all is done that need be done.

The *Appendix* itself is dealt with according to the nature of

the pathological processes in and around it. It has been found that it is not necessary for cure always to remove the appendix ; and it has been found to increase the risk to remove it where it is firmly embedded in adhesions or forms part of the wall of the abscess. A gangrenous appendix may easily, and should always, be removed. An appendix floating free in the cavity of the abscess should be removed, at least up to the seat of adhesion and beyond the perforation. But an appendix buried in adhesions, some of which may enter into the formation of the sac-wall, should not be disturbed. And in every case where the patient is very ill, completeness of operation should give way to the saving of life. No more than the patient will bear should be done when the immediate risk has been removed by provision of an external outlet for the collection of pus.

One objection to any form of cleansing of the abscess walls is that it causes bleeding, and the result may be formation of a clot. Such a clot is more than a nuisance, it is a real danger. No discharge from the abscess wall can escape by the side of the clot ; it is very prone to decompose, and it is a tedious and difficult proceeding to break it up and remove it.

The removal of the appendix in these cases can rarely, on account of abundant adhesions, be supplemented by inversion into the cæcum. Simple deligation and amputation beyond the ligature is, however, quite satisfactory in its results.

Into the abscess cavity a little powdered iodoform, or iodoform emulsion, or pure boro-glyceride may with advantage be placed. They lessen the putridity and probably accelerate healing.

Drainage must be very thorough, and should extend into every separate collection of pus. Rubber tubes are best. They should have thick walls so as not to be compressed or kinked, and they should be large enough to carry a small irrigating cannula inside, in case they become blocked by blood-clot. Efficient drainage is the most important factor in these cases— more important than cleansing of the abscess-walls, and even than removal of the diseased appendix itself.

In Simple Plastic and Relapsing Appendicitis the operation is not so much to save life as to cure disease and remove pain. A more deliberate operation is possible because the patient is less ill; and removal of the appendix should always be aimed at, as being the only certain method of cure.

Relapsing appendicitis being not so much a separate disease as a recrudescence or continuation of a plastic or catarrhal appendicitis, requires no separate description. The operation is performed during a period of quiescence, and, surgically speaking, this is its only peculiarity.

The *Parietal Incision* in these cases will vary according to the presence or absence of adhesions forming a tumour, and the position of such tumour. If there is no tumour palpable through parietes or rectum, the ordinary incision (Fig. 28, No. 5) may be employed. If a tumour is felt through the parietes, the incision is made over it rather towards the outside than the inside of it, and enlarged upwards or downwards after digital exploration has made out the probable or certain position of the appendix. If the thickening is felt only through the rectum, the incision should be made low down and well to the outside, whence access is shorter and more direct. As the amount of adhesion to be traversed before the appendix is reached is, in some cases, truly enormous, it is a great saving of time and of trouble to get to it through the shortest route. This is usually on the outside; and here also the abdomen is shallowest.

If there are no adhesions, or only slight or threadlike bands surrounding the appendix, its removal is a very simple proceeding after its discovery. As guides to the appendix, the brim of the pelvis and the caput coli are most readily available. A very short search of experienced fingers soon detects it. It is caught between the first and second fingers of the left hand and pulled to the surface; if there is any difficulty, a catch-forceps placed on its tip will be of use in helping delivery. If the tip of the appendix is adherent to any organ, and especially if to bowel, separation should be effected within view. In those rare cases where the appendix acts as a constricting band causing intestinal obstruction, isolation and separation should be done with great

care. In one such case on which I operated, the wall of the small intestine to which the tip of the appendix was adherent was drawn out into a sort of tube an inch long, and it was very difficult to make out the real seat of adhesions, more especially as the intestines were distended from obstruction and the appendix could not be brought to the surface. A catarrhal or cystic appendix is most easily discovered and most easily dealt with.

The greatest difficulties are met with in cases where adhesions and peritonitic thickening are most abundant. Some of these present difficulties almost as great as any met with in abdominal surgery, requiring the exercise of much judgment, tact, and patience. In dealing with such cases, a long incision is advisable, and the use of retractors and of sponge-packing may be of advantage. As has been already remarked, the first entrance through the adhesions is usually made on the outside. If the junction between cæcum or ascending colon and small intestine can be made out, this will usually be the most convenient point at which to begin separation. We work towards the area of greatest thickening; in the heart of this the appendix will be found. Intestines are carefully separated by finger and sponge: the intestine is carefully inspected at every step; if submucosa is exposed, even if the mucous membrane is entire, a Dupuytren's suture should at once be inserted. It may be necessary to use a cutting instrument to divide adhesions; but this should be done only when absolutely necessary, and under cautious guidance of touch. I have met with adhesions at least half-an-inch thick, and as hard almost as gristle, in a case where there had been about thirty attacks of appendicitis. It is impossible to formulate rules for guidance in the endless variety of conditions found in such cases; the surgeon must depend on the guidance of his educated judgment and sense of touch.

The appendix is often found partly surrounded with a little mucoid fluid, a secretion from its mucous membrane and glands which has escaped through the perforation. The adhesions in such cases are probably of the nature of a

phagocytosis, a heaping up of embryonic protective cells around a source of irritating exudate. In other cases there is no free fluid ; the appendix from base to tip is adherent to every contiguous organ and surface. The adhesions in such cases are likely to be fibrous and loose, rather than gristly and compact.

Isolation of the appendix is carried down as close as possible to its origin from the cæcum. It should always go beyond the perforation ; great density of adhesion may justify the leaving of its base unseparated and intact, but always the aim should be to effect complete removal.

The manner of amputation and treatment of the stump has been as varied in this as in other varieties of amputation, and all methods have had about equal proportions of success. As already remarked, simple encircling ligature close to the cæcum, with amputation beyond, has been as successful as any more elaborate method ; it is doubtful, therefore, if other than theoretical virtues reside in elaboration of the process. Fowler * employs a method of circular flap amputation, which he speaks highly of. "A temporary ligature is thrown round the base of the appendix, close to the cæcum. This is not tied, but simply twisted until it constricts the organ sufficiently to prevent the escape of fæcal matter from the cæcum, should the cavity of the appendix be accidentally invaded before the application of the final and permanent ligature. This temporary ligature should be sufficiently long to be grasped by a pair of clamp-forces at its extremity, which will aid in the twisting ; at the same time it will by its weight, when dropped outside the wound in the abdominal wall, prevent the untwisting of the ligature. A second ligature is applied and tied about the appendix at a point half-an-inch distant from the first ligature. A circular incision is now made, either by means of a sharp scalpel, or preferably by snipping with the points of the scissors, in the space between the two ligatures. This should include the serosa and the subserous connective tissue. A cuff-shaped flap formed of these structures is turned back towards the

* *Loc. cit.*, p. 162.

temporary ligature until the latter is reached, precisely as the cuff-shaped flap in a circular amputation of an extremity is turned back to uncover the underlying structures. A ligature of fine ordinary catgut is now placed around the wall of the appendix at the bottom of and within the reflected cuff of serosa, and as nearly upon the same level as the temporary constricting ligature as possible. . . . The ligature is tied tightly and cut off close to the knot. Its purpose is to prevent hæmorrhage from the cut surface of the wall of the appendix as the latter is cut away, and to shut off the cavity of the cæcum when the temporary constricting ligature is removed. The appendix is now cut away and the mucous membrane remaining in the stump touched with the thermo-cautery or fuming nitric acid. The cuff-shaped flap is now placed over the face of the stump, and the latter is grasped by means of a pair of dissecting forceps and crowded against the wall of the cæcum in such a manner as to form a furrow or depression in the latter; the edges of the latter are sutured together over the stump of the appendix by means of a double row of Lembert sutures, so as to bury the latter out of sight." Barker has independently described a method of cuff amputation very similar to this of Fowler.

Where I have thought some process more elaborate than simple encircling ligation advisable, I have employed double-flap amputation, with continuous Dupuytren sutures to the flaps. If the stump is turned inside the cæcum, the application of any ligature round the base of it seems to me superfluous. Complete involution, as shown in Fig. 177, turning the mucous membrane inside the cæcum, does away with all risks from impure mucous membrane in the appendix, and is possible only when the stump is not ligated. But all these processes are really refinements, not absolutely necessary, even if they are advisable.

The meso-appendix, if it is not small and not incorporated in the inflammatory process, should have separate treatment. It may after separation be, as Fowler suggests, opened up and raised over the appendicular stump as a cap or hood, and

fixed there by a stitch or two. This has the further advantage of preventing risk of adhesion of intestine to the stump.

In cases where the cavity is dilated and the walls are not thick, the base of the appendix may be inverted and bodily turned inside the cæcum, as shown in Fig. 177. This is perhaps the best of all methods, but it cannot always be carried out.

As to the suturing and dressing of the wound, nothing need be added to what has been said in the general consideration of the subject.

After-treatment.—This calls for no detailed description. In cases with perforation or diffusion of pus, abundant stimulation by means of rectal injections will be necessary. Where peritonitis with pseudo-ileus are established, the treatment must be on the lines already laid down (p. 139). Drainage, whether by gauze or by tube, is managed on the principles described for abdominal operations in general.

Cases of chronic appendicitis without general peritonitis proceed like any other simple case of abdominal operation, and are managed exactly as are other operations. (See p. 134.)

Perforating Ulcers of the Intestines.

Ulcerative destruction of the intestinal walls calls for operation when it extends into the general peritoneal cavity or into the sub-peritoneal connective tissue. General ulceration of the large bowel may be treated with a view to giving the parts rest by performing colotomy on the right side; direct treatment of any variety of intestinal ulcer with a view to cure has not yet been suggested. The ulcers which may demand treatment because of perforation are :—

Perforating Typhoid Ulcer.
Perforating Stercoral Ulcer.
Perforating Duodenal Ulcer.

PERFORATING TYPHOID ULCER.

Dr. James C. Wilson, of Philadelphia,[*] was the first publicly to recommend operation for perforating typhoid ulcer. Morton, also of Philadelphia,[†] in the same periodical of the same date recorded two operations, and carefully worked out the conditions for which, and under which, the operation may be performed. Van Hook[‡] collected 15 cases of operation with two recoveries, each of doubtful diagnosis. Altogether about 25 operations have been performed, and of these only one, that was undoubtedly a case of typhoid ulceration, recovered. Three and perhaps four cases that may have been typhoid, but were not certainly so, recovered. References to the individual cases will be found in Van Hook's paper and in the fourth edition of this work.

Now, a death-rate of anything approaching ninety per cent. for any operation is of doubtful value; and the question may seriously be asked if operation with such faint promise is ever justifiable. It may reasonably be urged that the few lives

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[*] *Phila. Med. Times,* Dec. 11th, 1886.   [†] *Loc. cit.*
[‡] *Phila. Med. News,* Nov. 21st, 1891.

saved were saved from certain death ; but it is open to question whether these may not be counterbalanced by other cases which might have recovered had operation not been performed. The question is a very difficult one, and at present a definite answer cannot be given to it. Van Hook considers that "the only contra-indication is a moribund condition of the patient." The difficulty is in deciding as to when the patient is moribund. Put more definitely, it must be admitted that there must be a selection of cases. Those which would most fully justify operation would be of the mildest or "ambulating" variety. Perforation frequently takes place during convalescence : a few of these cases may admit of operation. But, in a moderately severe case of typhoid, operation as a sequence to perforation must be undertaken with extreme caution. It cannot be denied that in a select class of cases the operation has a future before it, though such a future can never be very bright ; it is doubtful however whether, for the majority of cases of perforation, any operative interference should be contemplated.

The symptoms need not be described. It may be noted that the acute symptoms of sudden perforation, with abundant extravasation of visceral contents, are by no means always present. In a few the symptoms are simply those of peritonitis ; and, in some, the symptoms are so obscure that perforation is not even suspected.

As to the operation itself, I cannot do better than utilise Morton's description of it :

"Median incision will undoubtedly prove best in almost every case. It should be as long as is necessary for efficient work, and commence a little more above the pubes than is usual in such incisions. Extreme gentleness will be required throughout, as otherwise, perhaps in any case, other ulcers may be broken through. Let systematic search for lesions commence at once upon gaining admission to the peritoneal cavity, starting, in order, at the points most liable to involvement. We should examine the cæcum and its appendage ; then carefully go over the entire length of the small intestine continuously, from its termination in the cæcum to its origin at

the pylorus, by passing it between the fingers. This finished, in like manner the colon should be examined; then the mesentery, ovaries, liver, etc.

"What shall be done with lesions when found? This is a vital, and not an altogether answerable, question.

"Perforations, in the great majority of cases, will be found in the small intestine corresponding to the position of Peyer's patches. Occasionally a follicle ulcer will perforate near the mesenteric border, but probably never so close to it as to produce the trying injuries which are made by a bullet or knife. In the cæcum, or colon, perforation is equally liable to occur anywhere, except close to the meso-colon attachments. The usual position of these lesions is fortuitous, as the situation permits of most easy reparative treatment.

"Shall we resect a perforated bowel, simply turn in the borders of the perforation, or attempt the production of an artificial anus?

"In the lack of experience, nothing positive can yet be said upon this point. We do know that circular gangrene of intestine occurred in the single instance where exsection has been done; but this may possibly have been due to some defect of operation. A large perforation, or a small opening through the base of a very large deeply excavated ulcer, would probably require excision of a portion of bowel. Such an ulcer occurring in the small intestine would be in its longitudinal diameter; hence it can be turned into the bowel entire by Lembert sutures introduced beyond its lateral borders. This I should be inclined to think the best method of dealing with most perforations, or ulcers about to perforate. The possibility of narrowing the bowel immoderately must be kept in constant view; and where the above suggested mode of repair would undoubledly give rise to it, resection or artificial anus must be substituted.

"It is possible that the necrosis of bowel already alluded to resulted from the absence of resistance in tissues so profoundly poisoned and malnourished as, of necessity, are those of a typhoid individual. We do not even know what course the parietal

incision itself would follow; but I deem it probable that, with thorough cleanliness, such wounds could be induced to heal kindly. At the worst, happen what may, the patient can be in no more deplorable condition than before operative interference was carried out. We know nothing of what possibilities there may be in this direction, and I would plead for an attempt to reduce a mortality of one hundred per cent. If resection cannot successfully be done, and the affected area is too large for efficient stitching, then artificial anus would be another resource.

" Whether any one of these three methods of treatment is *the* one, or whether all will have occasional use, must be determined by trial and experience. The order in which I should suppose them valuable would be: stitching by Lembert's method, resection, and, lastly, artificial anus.

" In the examination of the intestine I should also be inclined to turn into the bowel lumen, by the same method of stitching, any seats of disease which appeared likely soon to perforate or to approach dangerously that condition. Cæcum and colon lesions could, probably in every case, be treated by simple stitching.

" Large irrigations with very hot distilled or medicated water are indispensable before closing the abdomen. Just as important will it be to drain these cases thoroughly, and for this purpose nothing answers so well as the leaving in of a Keith glass-drain. This tube can best be kept in working order . . . by carrying a rope of absorbent cotton (medicated, if preferred) to its bottom, and removing it as often as a wad of cotton placed over the outlet becomes saturated. The rope and superimposed cotton must be renewed as it becomes saturated, even as frequently perhaps as every couple of hours for the first day; afterwards at less frequent intervals, according to circumstances."

Irrigation with a hot lotion is recommended after the operation on the bowel is concluded; there would probably be no objection to irrigation while the operation is going on. A drainage tube should always be inserted.

PERFORATING STERCORAL ULCER.

Although no special description of this disease has, so far as the writer knows, been written; and although it is not of frequent occurrence nor of great importance; yet its undoubted existence and real gravity may justify its being classed under a separate heading.

My attention was called to traumatic ulceration of the colon twelve years ago, by finding in the contents of a large abscess in the left loin a rounded fæcal concretion as large as a bean and the actual perforation in the descending colon through which it had escaped. In another case, on the right side, with an abscess extending upwards as high as the diaphragm but not reaching down to the cæcum, a piece of bone from a mutton chop, which was known to have been swallowed a month previously, was found.

Since then about ten other cases have been operated upon; and perhaps three more which, while probably originating in perforation of the ascending colon, may yet have originated in the appendix. Only in four were actual fæcal concretions found. In a fifth case, after the wound had closed the patient had a second attack of cellulitis; a small fæcal concretion was found in the pus evacuated.

Ulceration may be caused in any part of the colon by the settlement or capture of hardened fæces or a foreign body. Stercoral ulcers produced by the presence of a large enterolith rarely perforate; they spread laterally rather than penetrate deeply. A piece of hardened fæces resting for long periods in one of the colic pouches may cause an ulcer as large as itself, and may go on towards penetration. A sharp foreign body, caught anywhere, may penetrate almost at once, or after a few weeks. Static ulceration of the colon, thus induced, naturally takes place in those parts of the bowel which are least mobile. As caused in the rectum, we are familiar with it under the name of "ischio-rectal abscess." As a comparatively rare disease, it is found also in the ascending and descending colon, and very rarely in the mobile transverse colon. The least mobile part of the colon is at its mesenteric

attachment, and here perforation is most common. Thus the abscess becomes extra-peritoneal. In the transverse colon, perforating ulcer may be a primary cause of bi-mucous fistula between colon and stomach, producing the symptom of intermittent fæcal vomiting.

The condition, as I have met with it, is simply a diffuse sub-peritoneal cellulitis. It is rapid in progress, is associated with considerable constitutional disturbance and with almost continuous high temperature. Rigors are common. There is not much tympanites, although the abdominal parietes, especially on the side affected, are tense and unyielding. Dulness on percussion may be absent : in one case there was marked increase of resonance, and there was found to be gas in the abscess cavity. Induration of the cellular tissue ahead of the suppuration is not so well marked in this variety of cellulitis as in most of those varieties arising in the pelvis or connected with the pregnant state. Cutaneous œdema in the later stages is always present; then the patient is probably very seriously ill, with rapid pulse and delirium.

The abscess, however originating, seems to burrow upwards towards the diaphragm, rather than down into the pelvis : this is probably in consequence of the patient having to take to bed and the supine posture almost from the beginning. Such an abscess may become subphrenic of the retro-peritoneal variety.

The matter when evacuated is of very foul fæcal odour, and is sometimes contained in loculi. Sloughs of cellular tissue may be cast off in the process of cure.

The treatment is simply incision and free and dependent drainage carried to the deepest recesses of the abscess-cavity. The employment of potent antiseptics will always be advisable. Irrigation, both at the time of operation and subsequently during the progress of the case, may be employed with advantage.

PERFORATING ULCER OF THE DUODENUM.

Although operations for perforating ulcer of the duodenum have been performed, and at least one success has been

recorded, it cannot be said that as yet any definite rules as to surgical procedure have been laid down. Almost uniformly operation has been performed for acute abdominal symptoms, probably caused by perforation; but the actual disease for which the operation has been performed has not usually been diagnosed. Even at operation, in some of the cases the seat of perforation was not discovered, and the nature of the lesion was only made out after death.

Still, material is rapidly accumulating on which may be founded rules for diagnosis and treatment, and it may be useful to summarise some of the most important facts so far as they have a practical bearing.

Amongst recent writings, the elaborate and philosophic paper by Drs. Perry and Shaw* will be found invaluable to the surgeon. Marmaduke Shield† has utilised a personal experience in two operations and a close study of the literature of duodenal ulcer, in formulating sound rules for operative treatment. Lockwood‡ has recorded three cases of operation by himself and given valuable practical hints as to diagnosis and treatment. Percy Dean § has had the first operative success. Pearce Gould, Gilbert Barling, and others have operated and have related valuable experiences.

Pathological Considerations.—Perforating duodenal ulcer is a rare disease. In 16 years there were only 3 cases recorded in the post-mortem books of St. Bartholomew's Hospital. In 31 years at St George's Hospital, only 12 cases were recorded,— "that is, 0.14 per cent. of total deaths and 10.34 of all perforations" of the intestines.‖

It occurs chiefly amongst adult males. Of the 12 cases at St. George's Hospital, 10 were males and only 2 were females; and the average age was 42 years, the youngest being 21 and the oldest 59. Of 56 cases collected by Perry and Shaw, 42

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* *Guy's Hosp. Rep.*, vol. l., 1893, p. 171.

† *Med. Soc. Trans.*, vol. xvii., 1894, p. 30.

‡ *Trans. Med. Soc.*, vol. xv., 1892, p. 91; and vol. xvii., 1894, p. 48.

§ *Lancet*, May 12th, 1894.   ‖ Shield, *loc. cit.*

occurred in males and 14 in females; or if burns be excluded, in which curiously the preponderance is on the side of females, the ratio was 42 males to 8 females. The average age at death in uncomplicated cases was 36.7 years.

The perforating ulcer is found usually in the first part of the duodenum and on its anterior wall. Perry and Shaw in 51 cases found that 48 were in the first part, 2 in the second, and 1 in the first and second parts. Of 28 cases they found 19 on the anterior wall, 6 on the posterior, and 3 on both surfaces of the bowel.

Duodenal ulcer is found associated with a variety of diseases. About one-sixth of the cases are found in patients suffering from Bright's disease. The association with burns and scalds has perhaps been made too much of : of 138 fatal cases at St. Bartholomew's Hospital, Lockwood found that only 1 had ulcer of the duodenum; while Perry and Shaw, in 149 cases, found 5 cases of duodenal ulcer. It is probable that duodenal ulcer is not so much a complication of the burn as a result of the sepsis that may arise in the course of healing : this would explain how the mortality from this cause has diminished in recent years. Tuberculous ulceration of the duodenum is usually associated with tuberculous disease elsewhere, and especially of the lungs. In connection with typhoid fever, with septicæmia, and with malignant disease, duodenal ulceration is sometimes found.

The minute changes which precede and accompany the formation of a duodenal ulcer need not detain us here. The results, after the ulcer has been formed, chiefly concern the surgeon. The most important of these is perforation, either directly into the cavity or indirectly after formation of surrounding adhesions with abscess. Hæmorrhage also, although not usually so free as in ulcer of the stomach, concerns the surgeon in respect both of diagnosis and of treatment. Hæmatemesis may be caused by ulceration of a large vessel in the pancreas; this is said to be a not uncommon cause of death in the ulcer associated with burns. The ulcer may heal and the cicatrix may contract so much as to cause actual stricture of the bowel.

Again, there may be great thickening of the tissues themselves, and this is specially seen in cases which threaten to perforate, or have perforated, but where the general cavity is shut off by the formation of adhesions.

Symptoms and Diagnosis.—In most cases the first indication of the existence of duodenal ulcer arises when perforation takes place. The disease is usually, as regards symptoms, latent; or produces evidence of its existence so vague and uncertain that accurate diagnosis of duodenal ulcer is very rarely made. Vomiting some hours after meals; occasional attacks of hæmatemesis or melæna; pain occurring some time after food and localised in the right hypochondrium are leading symptoms, but they are frequently absent. Local tenderness on pressure or on laughing have been described.

In perforation the symptoms are equally misleading. There is the sudden severe abdominal pain; the rapid and profound collapse; the increasing fixity and distension of the parietes, and the other well-known associated symptoms. The diagnosis rests mainly on the possibility of localising the pain; and this, unfortunately, is too often impossible. If the patient points to the right hypochondrium as the seat of the first attack of pain, we have a fact of great importance to guide us. But the memory of the first pain is soon forgotten in the rapid onset of general pains and "tormina" whose seat is usually at or below the umbilicus. And as Marmaduke Shield well points out, the seat of pain may be positively misleading from the onset of peritonitis at some point where the fluids may have settled at a distance from the perforation. If the attack has come on while the patient is erect the fluids gravitate into the pelvis, and there the chief focus of inflammatory mischief may exist.

The diagnosis from perforating gastric ulcer on physical grounds is almost impossible. Pain in the epigastrium or towards the right hypochondrium, with occasional vomiting and tenderness on pressure, might be caused by ulcer near to the pylorus either in stomach or duodenum. Symptoms of

sudden perforation in a patient with such a history would lead, in the case of an adult male, to a diagnosis of duodenal ulcer ; in the case of a young woman to a diagnosis of gastric ulcer. Beyond this, it is scarcely possible to carry the diagnosis outside the abdomen ; the diagnosis must be completed inside the abdomen after section of the parietes.

The presence of free gas in the cavity, as shown by disappearance of the liver dulness, is an important positive evidence of perforation ; but it is not often present, so its negation means nothing.

Operation.—The incision should be made directly over the probable seat of the perforation. This would be in the upper abdomen about two inches to the right of the middle line, and would pass between the fibres of the rectus. If two well-differentiated bundles of fibres are selected, a bloodless separation of them may be made for four or five inches, and free exposure of the parts is secured.

On opening the peritoneum the escape of gas is looked for and its odour noted. Fæculent odour is against origin from duodenum or stomach, and suggests colon or lower ileum. The nature of any escaping fluid would also guide us if it is other than peritonitic. Particles of semi-digested food would probably have escaped from the stomach. It has been pointed out that fluids escaping from the duodenum should have an acid reaction ; but this would soon be neutralised by exuded peritoneal fluids.

Noting such evidences as any gas and fluid may give, we now proceed to explore. The pylorus is caught and pulled to the surface, and the anterior surfaces of the stomach and the duodenum are examined. A perforation here can scarcely be overlooked, as it will certainly be surrounded by evidences of inflammation. The perforation is at once closed by a double row of infolding sutures, as already described for gastric ulcer. It is unnecessary to excise the ulcer. It is fortunate that the ulcer is so often in the first part of the duodenum ; if it is not discovered here, however, the second and third parts

must be examined. The exploration would not be complete till the lesser cavity has been exposed by tearing through the gastro-colic omentum and entering it from the front.

To keep the wound open Maunsell's retractor, or two strong sutures passed through the recti and pulled apart by assistants, may be employed. If the duodenum can be kept forwards by sponge-packing or by traction, retractors will not be necessary.

The next step is to cleanse the abdomen, and this should be done very thoroughly. As already stated under the description of operation for gastric ulcer, I consider it better to employ great quantities of fluid under low pressure than to send a forcible stream through the abdomen. Nor need we confine ourselves to one irrigating tube, but several may be used placed in different parts of the abdomen. The best fluid for irrigation is, in my opinion, a solution of boro-glyceride, one ounce of the salt to a pint of water, and it should be about 105 degrees Fah. in temperature. Every part of the abdomen is successively penetrated by the tubes; and particular care is given to the irrigation under the liver and stomach. The making of a second incision over the pubes to aid in the irrigation of the pelvis may be of advantage.

When the cleansing has been satisfactorily finished a drainage tube is inserted. Here the seat for drainage suggested by Rutherford Morrison, in the most dependent part of the parietes, offers advantages which are evident. An incision in either loin, or even over the pubes, if there has been much fouling of the pelvis, may with propriety be made. But we must not forget that the patient will not bear much operating.

After the operation shock is likely to be profound. Before operation rectal injection of brandy will have done something to ward it off. In bad cases the intra-venous injection of saline solution may to advantage be made. Mr. Gould in his case injected thirty-two ounces of saline solution into his patient's veins after operation.

Section VIII.

OPERATIONS ON THE KIDNEYS AND THE URETERS.

SUMMARY.

OPERATIONS ON THE KIDNEYS AND THE URETERS.

By far the most important part of this section is devoted to the surgery of the kidneys. The surgery of the ureters, although it is as yet comparatively undeveloped, has already attained to an importance which seems to demand separate consideration. Suprapubic cystotomy might with propriety have been included with the surgery of the kidneys and the ureters, under a general section dealing with the urinary organs: the peculiar nature of the operations, and the length and importance of the subject, seem to warrant the giving of a separate section to operations on the bladder.

OPERATIONS ON THE KIDNEYS.

The surgery of the kidneys might be arranged under the three heads of incision, removal, and fixation. Incision is performed for the evacuation of cystic and purulent collections, and for the removal of stone: the first class of operations is known by the name Nephrotomy (νεφρός—kidney, and τομή—incision); the second is specialised as Nephro-lithotomy (νεφρός, λίθος—stone, τομή). The kidney may be removed for any of the conditions which justify nephrotomy, and specially for solid new growths. The operation of excision of the kidney is named Nephrectomy. Operative fixation of a movable kidney is usually named Nephrorraphy (νεφρός, ῥαφή—suture). As, however, stitching is not an essential part of the operation for fixing a movable kidney, some other word, such as Nephropexis or Nephropexy (πήγνυμι—fix), would be more exact. This word, suggested in a previous edition of this work, has now come into general use. Nephrorraphy is properly applicable to the stitching up of wounds in the kidney.

SURGICAL ANATOMY OF THE KIDNEYS.

The size of the kidney in health is about 4 inches in length, $2\frac{1}{2}$ inches in breadth, and between $1\frac{1}{4}$ and $1\frac{1}{2}$ inch in thickness. The right kidney is a little shorter and broader than the left.

The kidneys lie deep in the lumbar regions, embedded in capsules of fatty tissue. Each kidney overlies portions of the diaphragm, the transversalis aponeurosis, and the psoas muscle. Vertically, the position of the kidneys is liable to some variation in health and in disease. Morris* says that "the upper edge of the kidney corresponds with the space between the eleventh and twelfth ribs, and the lower edge is nearly on a level with the middle of the third lumbar spine." This is probably correct; it certainly corresponds with a good many observations which I

* *Surg. Dis. of Kidneys*, p. 2.

have made. Braune places them in similar position, the left being a little higher. Luschka's observations correspond, or place them about half an inch higher still. The ordinary descriptions in the text-books place them about half a vertebra too low. The level of the hilum, the part which concerns us most, is practically that of the first lumbar vertebra; that is, just clear of the ribs behind, and overlapped by the floating ribs in front.
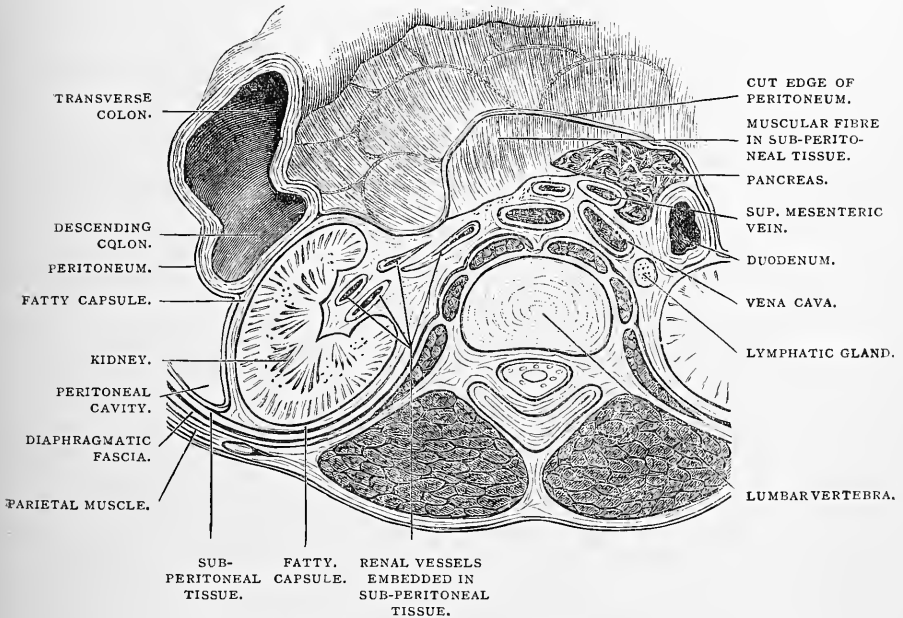
FIG. 178. (MORRIS's *Anatomy*—ANDERSON.)

Diagram showing relation of Kidney to Capsule.

The long axis of the kidney is not accurately vertical, nor are its surfaces anterior and posterior. This will be best understood by saying that if the vertical axes were prolonged upwards, they would meet near the anterior surface of the body at an angle of about forty degrees; while if the transverse axes were prolonged forwards, they would meet in front of the vertebral column at an angle of about sixty degrees. The upper end lies

deeper and nearer to the spine than the lower.   It might truth-
fully be said that the surface known as the anterior has just as
much right to be known as the exterior.

The right kidney, on its upper and anterior aspect, is in con-
tact with the under surface of the liver.   This fact may explain
its slightly lower position, and its greater tendency to become
displaced.   In direct contact with its anterior surface, where they
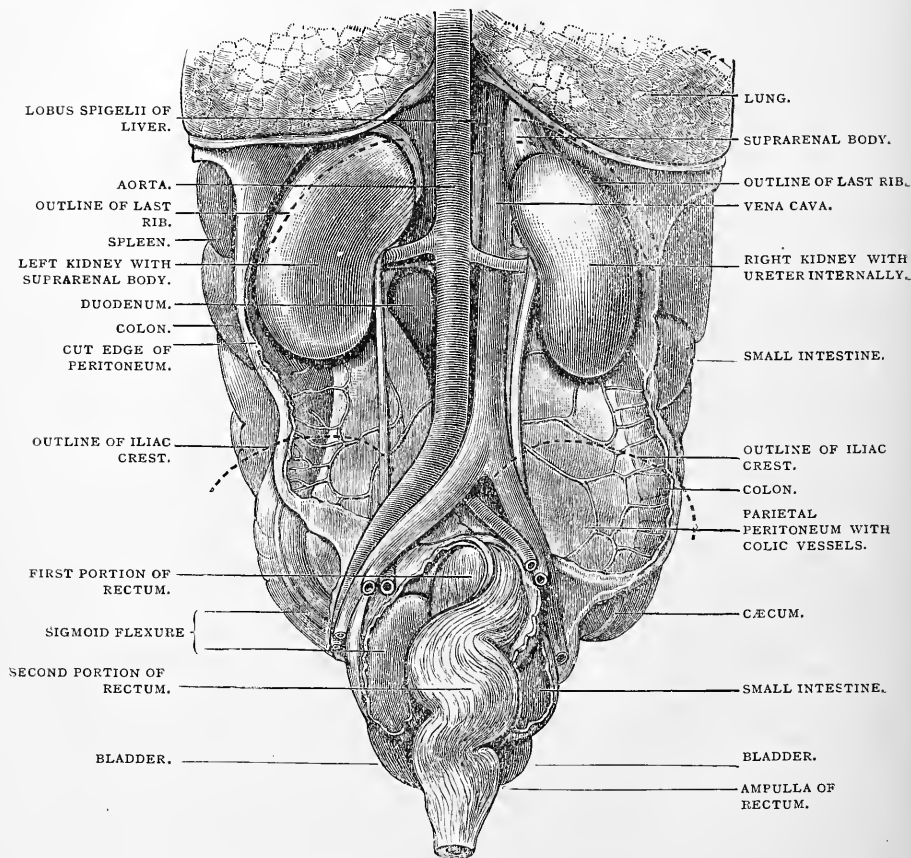
Fig. 179. (MORRIS'S *Anatomy*—ANDERSON.)

The Abdominal Viscera seen from Behind.

The Kidneys are somewhat lower than usual in relation to the ribs.

are uncovered by peritoneum, are the duodenum and the junction of the ascending with the transverse colon. The top of the left kidney touches the fundus of the stomach: the upper two-thirds of its external border is in relation with the spleen; in front, towards the inside, lies the pancreas; and crossing its anterior surface lower down, is the beginning of the descending colon. The position of the colon in relation to the kidney is of importance in diagnosis, as well as in operation. When the kidney becomes enlarged, the colon, bound down to it under the same peritoneum, is carried in front of it. Renal tumours, of necessity growing downwards, burrow under the colon and push it forwards. On the right side the ascending colon is usually found to lie vertically on a renal growth; on the left side, the transverse and the descending colon pass obliquely in curvilinear direction from above downwards and outwards. In the layer of peritoneum which passes backwards from the colon to the mesentery lie the vessels which supply the colon; and any serious injury to these vessels, such as might be caused by peeling peritoneum off renal growth, is fraught with danger to the vitality of that portion of bowel. The peritoneum which passes from the colon over the tumour towards the abdominal wall may be divided without fear of injuring the vascular supply of the bowel.

Fig. 180. (*After* Weisse.)

Structures in the Hilum of the Left Kidney viewed from behind.

A, Artery; V, Vein; P, Pelvis; U, Ureter.

The structures at the hilum (Fig. 180) of the kidney—the

artery, the vein, and the ureter—are of special importance, because they form the pedicle in cases of extirpation. The direction of the vessels from the aorta and the vena cava is practically transverse. The right artery ascends a little to its kidney, its origin from the aorta being a little lower down than the left ; it is also longer than the left, owing to the position of the aorta to the left of the middle line. The right artery passes behind the vena cava. Just before entering the hilum, where the vein is said to lie in front and the ureter behind, the artery breaks up into four or five branches, which are distributed to the renal tissue. These branches may occupy any position in front of, behind, or by the side of their corresponding veins. Small branches are given off to the supra-renal body, the ureter, and the neighbouring connective tissue. The renal veins are a good deal larger than the arteries and overlap them. The left vein is longer than the right, having to cross the aorta to enter the vena cava. Into this vein the left spermatic and the left inferior phrenic veins discharge themselves (Fig. 181) ; both vessels are quite within reach of injury in dealing with the renal pedicle. At the hilum the veins branch quite as much as the arteries, and the subdivision extends farther towards the middle line. In the post-mortem room, in about twenty subjects examined on this point, I have been surprised at the frequency with which two or more trunks represent the renal vein, sometimes surrounding the artery. Variations in the artery are by no means rare. This want of uniformity in the renal vessels is against the possibility of ligaturing artery and vein separately. In scratching or cutting open the pelvis of the kidney, it is quite possible to wound a vein. Though the kidney is a very vascular organ, yet, as its vessels run in a straight course towards the convex border, and do not anastomose to any extent, an incision may be made from cortex towards hilum without causing dangerous bleeding. The accompanying drawing (Fig. 181) is an accurate representation of the photograph of a dissection specially made to show the relations of the parts concerned in operations on the kidneys. It will be noted that on both sides the renal veins dip behind the arteries, and enter the hilum between them and the ureters. This is not

as the books on Anatomy put the relations; but as in four bodies in which I have carefully looked into this point, and in a good many more in which I have made rough post-mortem investigations, I have always found it so—that is to say, always artery in front and vein behind,—the relations figured must be common. The breaking-up of the renal arteries, soon after leaving the aorta on the right side and before entering the hilum on the left, is a common arrangement.
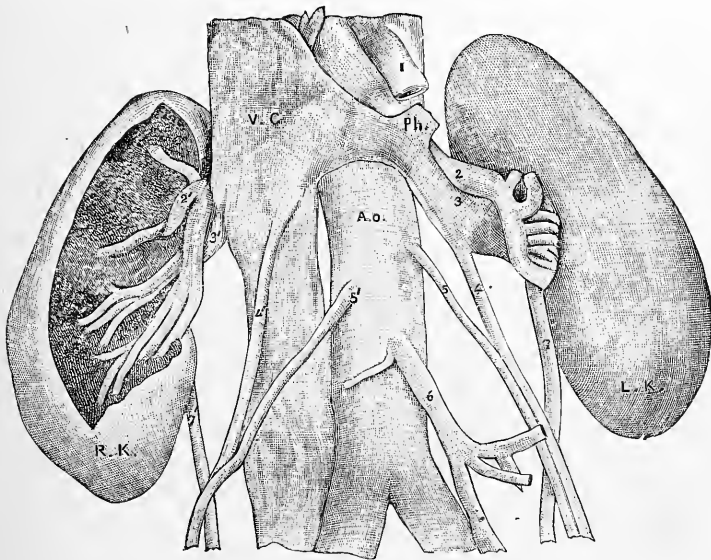
FIG. 181.

Drawing from photograph of dissection made to show relations of parts in operations on the Kidneys.

R.K. Right Kidney. L.K. Left Kidney. Ao. Aorta. V.C. Vena Cava. Ph. Left inferior Phrenic Vein. 2 and 2′. Left and Right Renal Arteries. 3 and 3′. Left and Right Renal Veins. 4 and 4′. Left and Right Spermatic Veins. 5 and 5′. Left and Right Spermatic Arteries. 1 and 6. Mesenteric Vessels. 7 and 7′. Left and Right Ureters.

At the lower border of the kidney the ureter begins to expand into the funnel-shaped sac known as the pelvis. In the hilum the pelvis gives off two or three short trunks, which in their turn subdivide and form the calyces or infundibula which open over and grasp the papillæ. Jordan Lloyd* has found that many of

* *Birm. Med. Rev.,* Dec. 1886.

the primary tubes are more than an inch in length, and no larger than a No. 10 catheter; while the secondary tubes run as fine as a knitting-needle. In such cases, it is evident that a finger inserted into any part of the pelvis could not possibly make a complete examination of the calyces; and, on the other hand, it may be added, that a stone impacted in one of the primary tubes could not be removed through a secondary tube opened up by an incision confined to the renal structure. The accompanying drawing (Fig. 182), which is more true to nature than any other I have seen, shows clearly the truth of Mr. Lloyd's contention.

The pelvis passing downwards and inwards from the hilum, gradually contracts to form the ureter. The ureter is said to begin at the lower border of the kidney, and passes downwards and inwards behind the peritoneum to its insertion into the base of the bladder. From above downwards, it is in relation with the psoas muscle and the genito-crural nerve; at the brim of the pelvis, it crosses the external iliac vessels on the right side, and the common iliac vessels on the left; thence it passes in the fold forming the posterior false ligament of the bladder to its insertion. All through its course the ureter is very loosely attached to the cellular tissue in which it lies. More will be said of the relations of the ureters further on.

Fig. 182. (Heitzmann.)

Pelvis and Calyces of the Kidney prepared out of the Renal Substance.

1. Minor Calyces. 2. Major Calyces. 3. Pelvis. 4. Ureter.

The kidney lies in a bed of fatty tissue known as the tunica adiposa. The amount of fatty tissue surrounding the kidney

varies greatly in different individuals, but it is always considerable. In this elastic bed the kidney enjoys some liberty of movement ; when the kidney is exposed from the loin, as in the operation for nephro-lithotomy, it may be seen moving regularly upwards and downwards synchronously with the ascent and descent of the diaphragm during respiration. The kidney is usually supposed to be kept in place by this fatty envelope, and a certain influence in keeping it in position must no doubt be thus exerted ; at all events, excessive mobility is found in some cases after there has been a rapid loss of fat. But other influences combine to keep the kidney in place. The original investigations of Cunningham* and of Kendal Franks† prove that the shape of the kidney itself in the midst of its surroundings is an important factor in determining its fixity. The anterior surface of the kidney is flatly wedge-shaped; and the resultant of the forces pressing on these inclined planes, if equally balanced, would be to press the kidney backwards and so keep it in position against the firm parietes. " In every case," Cunningham says, " and on both sides there is on the anterior surface a point of maximum convexity, a place where the kidney substance is raised in the form of a marked

Fig. 183.   (ANDERSON—MORRIS's *Anatomy*.)

Diagram of relations of the Posterior Surface of the Kidney.

(The diaphragmatic area usually extends lower than this on the left side, and the eleventh rib may come into indirect relation with its upper end.)

* *Journ. Anat. and Phys.*, July, 1895.   † *Brit. Med. Journ.*, Oct. 12th 1895.

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prominence or bulging, which may slowly rise from all sides
to a blunt summit, as is usually the case in the left kidney ; or
which may extend across the anterior surface in the form of
a rounded ridge, as happens more commonly in the case of
the right kidney.   Above and below this eminence the anterior
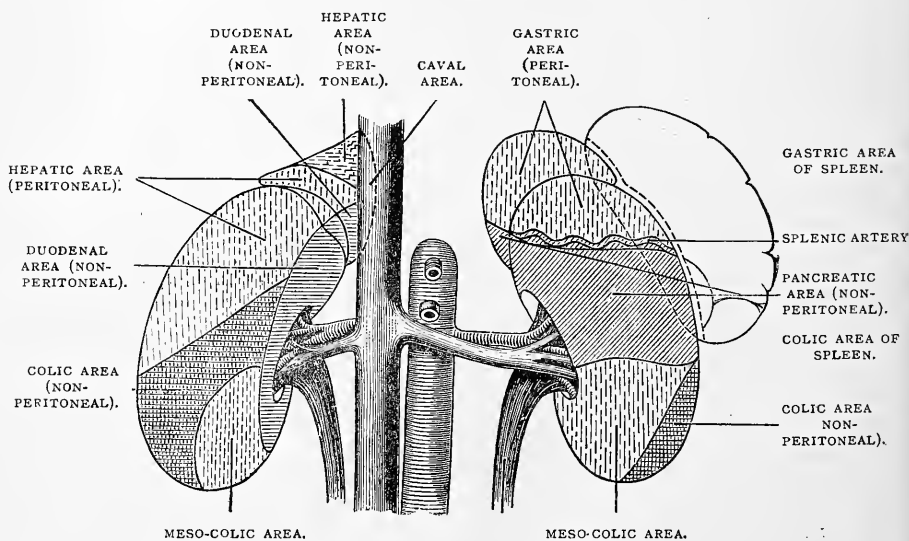
FIG. 184.   (MORRIS'S *Anatomy.*)

Diagram showing anterior relations of Kidneys and
Suprarenal Bodies.

surface falls away towards each extremity in the form of an
inclined or sloping plane of greater or less obliquity.   These
impressed districts indicate pressure exercised on the anterior
surface of the kidney in two directions, and the intervening
eminence is the result of this counter-pressure.   Upon the upper
inclined plane of the anterior surface of the left kidney are placed
the supra-renal capsule, the stomach, and the spleen.   These

exercise a downward and backward pressure. . . . Upon the inferior inclined surface of the left kidney the counter-pressure is produced by the intestinal canal, which presses, as a rule,
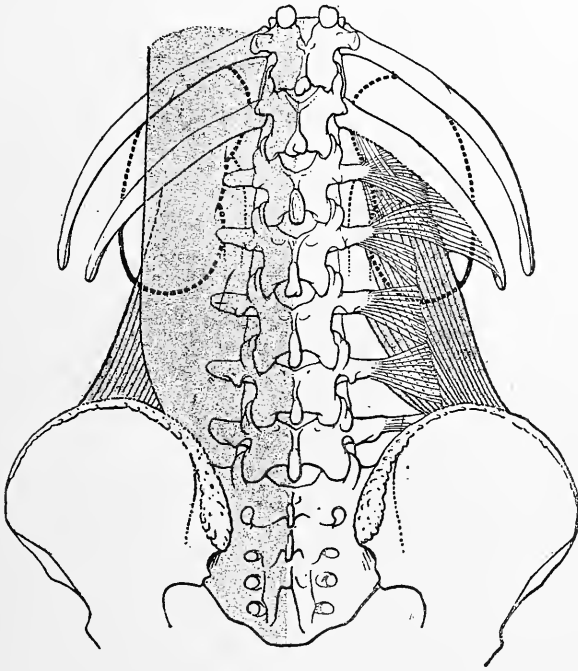
FIG. 185. (TH. RÉCAMIER.)

*Diagram showing the relations of the Kidneys to the Lumbar Muscles, the
Vertebræ and the Lower Ribs.* Twelfth Rib long.

upwards and backwards. . . . On the right side the upper inclined surface is occupied by the liver, whilst in contact with the lower inclined area is the colon. In many cases the colic or inferior sloping surface presents a high degree of obliquity."

Besides the double plane and intervening ridge on the anterior

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renal surfaces, other markings are found. "The duodenum almost invariably rests upon the anterior surface of the kidney, and it gives rise to a very evident duodenal impression. The outer
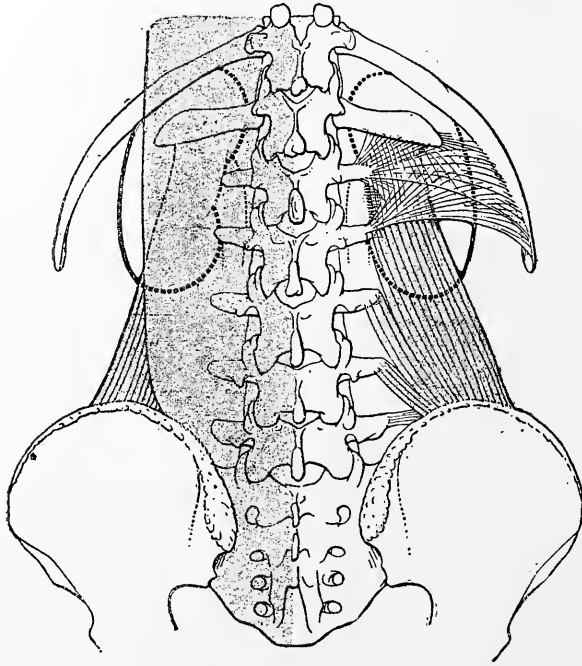
FIG. 186. (TH. RÉCAMIER.)

Diagram showing the relations of the Kidneys to the Lumbar Muscles, the Vertebræ and the Lower Ribs. Twelfth Rib short.

convex border of the kidney of both sides presents a marked thickening opposite the eminence on the anterior surface. In the neighbourhood of this thickening a faint groove, passing upwards, indicates the place where the border of the kidney is 'clasped' by the last rib. . . . The posterior surface of the kidney

exhibits three well-marked areas, which correspond respectively
to the psoas internally, to the quadratus lumborum externally, and
to the diaphragm above. Between the areas marked by the psoas
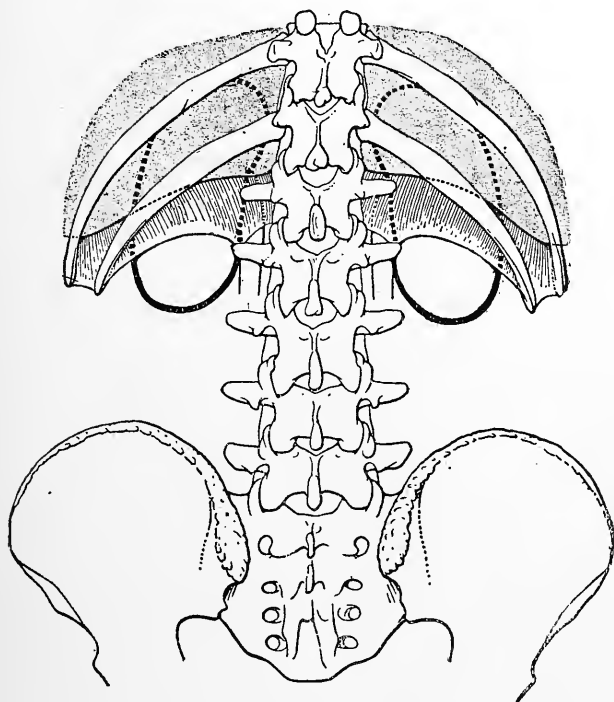
FIG. 187. (TH. RÉCAMIER.)

Diagram to show the relations of the Kidneys with the Diaphragm and the
Pleura. Twelfth Rib long.

and the quadratus lumborum muscles dimples corresponding to
the transverse processes of the lumbar vertebræ may sometimes
be observed in spare subjects."*

The importance of these observations of Cunningham and

* Kendal Franks, *loc. cit.*

Franks in connection with movable kidney can scarcely be over-rated. Their truth, since my attention has been called to them, I have had frequent opportunities of verifying.
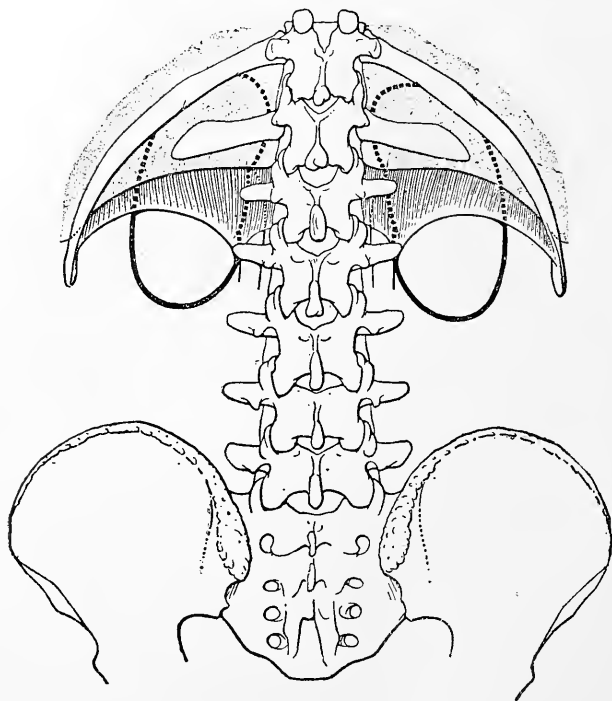
FIG. 188.   (TH. RÉCAMIER.)

Diagram to show the relations of the Kidneys with the Diaphragm and the Pleura.   Twelfth Rib short.

In operations upon the kidney, the lowest limits of the pleura and its relations to the twelfth rib are of importance. Dum-reicher of Vienna, in an operation upon an enlarged kidney, by misadventure opened the pleura. Holl of Vienna and Lange of New York have made studies on this point which show that the

last rib is frequently so short as to be overlooked, and that the
pleura descends as low as if the twelfth rib were of normal length.
(Figs. 185—188.) The lower edge of the pleura passes horizon-
tally between the lower boundary of the twelfth dorsal vertebra
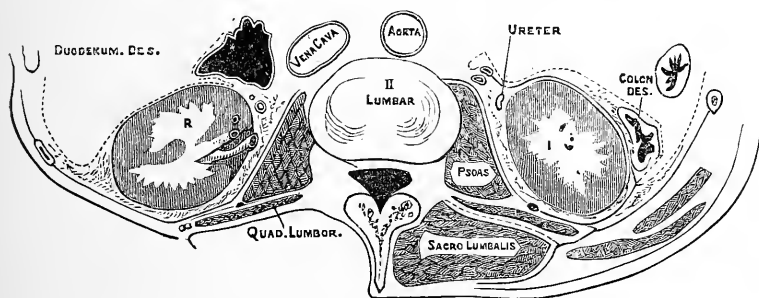
FIG. 189. (LANGE.)

*Horizontal Section of Body between Second and Third Lumbar Vertebræ (surface
of Upper Section seen from below, i.e. right side to left hand), showing relations
of Kidneys to Peritoneum (marked by dotted lines) and Muscles.*

and the lower edge of the eleventh rib, whatever be the condition
of the twelfth rib. It is peculiarly necessary, therefore, that the
upper limits of incision should be marked rather by counting
the ribs before operation, than by feeling the presence of the
bony rib during operation.

Nephropexy—Nephrorraphy.

By this operation is meant the fixation of a kidney that is movable. It need not be the replacement of a misplaced kidney; nor does the operation, as already remarked, of necessity involve the placing of sutures. With simple misplaced kidney, congenital or acquired, we have here nothing to do : the existence of such a condition is usually discovered for the first time in the post-mortem room. It is where there is not only displacement but want of fixation, and where this mobility begets troublesome symptoms, that the operation to be described may be called for.

Pathological Anatomy of Movable and Floating Kidney.—Two forms of displaced and not fixed kidneys are described—Movable Kidney and Floating Kidney. In Movable Kidney the movements are entirely sub-peritoneal. They take place in a space artificially created in the areolar tissue which binds the peritoneum to the underlying muscles. In Floating Kidney the movements are intra-abdominal; that is to say, the kidney is surrounded by peritoneum, and possesses a meso-nephron. The former is acquired ; the latter is congenital.

Movable Kidney.—A certain amount of mobility, to the extent of an inch or an inch and a half, is not very uncommon,

especially in women with flaccid abdominal walls who have borne a large number of children. Here the mobility of the kidneys is of a piece with want of stability in the position of other abdominal organs, and is of no practical moment. In greater degree the mobility may be associated with certain changes in the tissues which are in immediate relation with the kidneys, and in some instances with changes in the tissue of the organ itself.

The kidney moves behind the peritoneum in a loose bed, which, according to Newman, may be formed in various ways. The adipose tissue which closely envelops it may become loosened all round, and the kidney may move about in the potential space so created. Or, the fatty tissue immediately surrounding the kidney may remain undisturbed, while the kidney with its fatty capsule may move in a space formed by the separation of peritoneum in front from muscle behind. Or, there may be a double mobility inside the capsule and behind the peritoneum. In every case there will probably be a notable diminution of circumrenal fat. In a considerable number of cases lengthening of the renal vessels has been found.

The amount of mobility varies from an inch or two to the extreme distance which the double attachment of renal vessels and ureter will permit.

The movable kidney is usually perfectly healthy; but occasionally lesions are found in an association with mobility which can scarcely be regarded as other than one of cause and effect. Thus, Dickinson * has found pyelitis associated with movable kidney; and Fritz † relates a similar association, both in his own experience and in that of Urag. Landau ‡ punctured many times a hydro-nephrosis in a movable kidney, which ultimately became purulent, and was successfully opened and drained. Hickingbotham had a case of death from pyelitis in a wandering kidney. Kehrer traces a connection between blocking of the ureter of a movable kidney by torsion or kinking, and hydro-nephrosis. In this category, as a probable cause of hydro-nephrosis, Dickinson places calculus or gravel, and further

* *Renal and Urinary Affections*, vol. iii., 1883.   † *Archiv. Gén. de Méd.*, 1859, vol. ii.
‡ *Die Wanderniere der Frauen*, Berlin, 1881

offers the suggestion that temporary dilatations of the pelvis by
an obstructing calculus, by increasing the size of the organ,
may, when the swelling disappears, cause loosening of the
kidney in its bed, and so start the mobility. Pyelitis may thus
be a cause of mobility. In such cases peri-nephritis may be set
up : occasionally this is so severe as to cause adhesion to neigh-
bouring organs, and especially to the liver.

  Floating Kidney.—A floating kidney has been defined by
Jenner* as one "that has a mesentery, a fold of peritoneum
attaching it very loosely to the spine." It is, indeed, probable
that this definition is too precise. The investigations recently
carried out under the auspices of the Pathological Society of
London would seem to show that one variety of displacement
may merge into another, or rather that a movable kidney may
so drag out its peritoneal covering as almost to cause the forma-
tion of a meso-nephron. To surgeons, as Morris very properly
points out, the main consideration is, whether or not the kidney
has a meso-nephron ; that is, whether it can be reached by an
extra-peritoneal operation from the loin.

  Floating kidney is very rare. It is always congenital, and is
frequently associated with other abnormalities in the disposition
of the peritoneum. In at least two described cases, malforma-
tion of the large intestine has been found. The renal vessels
have been found elongated. General laxity of the peritoneum
has been found in more than one case of true floating kidney.

  Causation of Movable Kidney.—Renal mobility has probably a
manifold origin, and can rarely be attributed to any single cause.
In some degree it might be classed with uterine displacements and
hernia, and be ascribed, in the language of evolution, to a too
early and too absolute assumption of the erect posture. One
explanation of its origin might almost be given in an expression
of wonder how, considering the very imperfect fixation of the
organ, displacement does not take place oftener than it does.

  Sex and age have something to do with the causation. It
is at least six or seven times more common in women than in

    * *Brit. Med. Journ.*, 1869, vol. i., p. 43.

men, according to the investigations of Newman, Roberts, Ebstein and Dickinson. Traumatism or strain alone therefore can have little to do with its origin. It originates usually during adult life or middle age, and is extremely rare in childhood and in old age. Of 290 cases collected by Newman, 81 per cent. occurred between the ages of twenty and fifty.

The right kidney is affected four times more frequently than the left ; about one-tenth of all cases have both kidneys mobile. Mobility of the left kidney alone is extremely rare.

These facts would suggest that anatomical conformation has as much to do with the causation of the mobility as anything else. A close observation of actual cases has convinced me that this is so. Women with long flexible spines and with sloping lower ribs which do not rise well forwards but lie closely over or in contact with the kidney provide the most abundant examples of the condition. A considerable proportion of the patients are in the upper classes, and most of them have been addicted to violent exercises such as riding, tennis, or gymnastics. I have often in these cases, while the patient is lying supine, been able by pressing firmly on the right lower ribs to make the kidney jump out of its bed. If while pressure is made on the lower ribs the patient is made to flex the thigh against resistance, so contracting the psoas, and to turn to the left while the pelvis is fixed, the dislocation is made much easier. The only occasion where I have had to operate on mobile left kidney (the right not being mobile) was in a patient who had lateral curvature of the spine ; and there was literally no room for the kidney between the ribs and the spine. A long flexible spine, ribs sloping downwards and not arching forwards, and a flat, small and slender upper abdomen give the bodily conformation which most favours mobility of kidney. The kidney is in a condition of frequent unrest between the mobile spine and ribs, and it may be started from its bed by an easily understood association of movements.

Another class is found in middle-aged women who have borne several children in rapid succession, who have lost flesh, and who are accustomed to severe manual labour. General

instability of the abdominal viscera is usually found in such
cases with laxity of the parietes. It has been supposed that
such cases provide the most frequent examples of renal mobility;
this may be so pathologically, but such cases as come under
the observation of the surgeon for treatment are, in my
experience, mostly to be found in the class previously described.

Increase of weight in the kidney may be a contributing cause.
I have seen an example of excessive mobility of the right kidney
which had become hypertrophied in consequence of complete
calculous atrophy of the left kidney. The patient, who was not
operated upon, died of pneumonia, and the specimen, with great
elongation of the renal vessels, is now in the museum of the Bristol
Infirmary. Tumours, whether as cause or as consequence, have
been found associated with mobility of the kidney. Menstruation
has, by several observers, been noted as a possible cause of
temporary increase in size: Sawyer, in particular, called attention
to this; and Newman found an aggravation of the symptoms
in a movable kidney during menstruation, while he thought he
also detected an increase in its size.

Absorption of circumrenal fat, as part of general emaciation,
may confidently be set down as predisposing to mobility.
I have found renal mobility in a case of cancer of the stomach;
I have known it follow a serious illness undergone in India
and followed by great emaciation; and I have met with it as
following a serious and prolonged attack of typhoid fever.

The frequency of mobility on the right side as compared
with the left is usually set down to the proximity of the liver,
which, in its movements downwards, forces the kidney in front
of it. The position of the colon; a mal-arrangement of the
structures surrounding; an unusually flat kidney; and other
conditions whose importance has not yet been estimated may
all contribute to start the organ from its bed. When once it
is started, repeated movements or jerks add to the displacement.
The influence of such jerks is cumulative; every inch gained
adds to the ease with which another inch is gained till the
limits of mobility are reached, when it drags on its own vessels
and ureter.

Symptoms.—The subjective signs of movable kidney range from mere discomfort to intense pain. The symptoms tend to vary according to the amount of mobility. Thus, slight degrees of mobility may be troublesome only after undue effort or exercise; extensive mobility rarely leaves the patient free from pain, and is often associated with positive agony.

The most common symptom is a dull, aching, or dragging pain in the loin, shooting down the abdomen towards and along the thigh. This pain is increased by exertion of any sort, and particularly by long walks or rides. The pain is aggravated by constipation; and it is often increased during the menstrual period. Occasionally paroxysmal attacks of pain come on, not unlike nephritic colic. In these attacks are sometimes found symptoms of blocking of the renal artery or ureter: such are, suppression of urine, with headache, vomiting, foul tongue, and other symptoms of uræmia. Transitory attacks of hydronephrosis may be caused by torsion of the ureter. Very frequently there is considerable intestinal or stomachic disturbance, shown by dyspepsia, flatulence, colic, sickness, anorexia, and diarrhœa. In a few cases transient attacks of jaundice have been observed. Frequency of micturition or even tenesmus may be present. All such symptoms are relieved by lying down. Pyelitis may show itself by the presence of pus in the urine. Œdema of one leg,* and jaundice from pressure upon the common duct,† have been noted. Those symptoms which may be considered as suggesting renal strangulation are found associated with an increase in the size of the movable tumour.

The disorders of digestion, flatulence or vomiting associated with movable kidney, Kendal Franks ingeniously explains by kinking of the duodenum induced by traction on the tissues which join the right kidney to the duodenum. In cases where the mobility is not of the kidney alone, but of the kidney with its fatty capsule, it is difficult to see how descent of the organ can take place without some amount of dragging on the duodenum, so

* Giraud, *Journ. Hebd. de Progrès des Sc. Méd.*, 1836, vol. iv., p. 445.
† *Brit. Med. Journ.*, Jan. 29th, 1876.

intimate are their connections. I have operated on only three cases where the gastric symptoms were strongly marked; in all fixation of the kidney was followed by disappearance of the gastric troubles. Movable kidney on the left side is believed by Franks not to be associated with gastric disorders; he mentions one case, however, in which the kidney in its descent dragged the splenic flexure with it, so causing kinking of the colon and intractable constipation, which the operation cured.

A few cases present anomalous and irregular symptoms which are very misleading and difficult to account for. Acute pain and tenderness at a point in the course of the ureter I have several times observed. In one of these cases the patient's medical adviser, who knew she had wandering kidney, suspected malignant disease of the spine; and her emaciation and inability to move lent weight to this view. Suspecting impacted stone in the ureter, I explored but found nothing; the whole of the symptoms disappeared after nephropexy. In another patient, whose symptoms were almost bewildering in their variety, I was persuaded to operate by a valued friend and colleague almost against my judgment to find that he was right and I was wrong, for the clouds of symptoms vanished after nephropexy. Such and similar observations in a somewhat extensive experience of wandering kidney have convinced me that as a *vera causa* of the multifarious troubles which may arise in a woman's abdomen we dare never overlook a movable kidney; such a patient, before acquiescing in hopeless invalidism, should have her movable kidney fixed.

Diagnosis.—Wandering kidney may have to be diagnosed from :

> Distended Gall-bladder,
> Tumours of the Omentum,
> Tumours of the Pylorus,
> Growths in the Intestines and
> Impacted Fæces.

From *Distended Gall-bladder* it is often most difficult to diagnose movable kidney. Morris* in a recent paper has clearly

* *Brit. Med. Journ.*, I., 1895.

expressed and fully illustrated this fact, which must have impressed itself on everyone who has much to do with the surgery of the abdomen. The difficulty is most likely to be met under two conditions: one where the liver is very loosely fixed and is readily moved and rotated, this being generally associated with lax parietes and a general looseness of the whole of the abdominal organs; the other where the parietes are hard and muscular, and palpation is difficult. In the one case the gall-bladder is very mobile and is easily pushed out of reach, so simulating kidney; and in the other fixity of parietes prevents us from pushing the kidney up and so simulating gall-bladder. In a considerable number of cases the conditions of mobile kidney and distended gall-bladder co-exist and add to the confusion; I have operated on two such, and Morris has had experience of several cases.

In making the actual diagnosis between distended gall-bladder and movable kidney palpation is, I think, most to be relied upon. The oblique direction of the growth of the gall-bladder tumour from the eighth rib towards the umbilicus will scarcely help us in a doubtful case, for the tumour has grown before we see it, and it is probably too small and too mobile to have any definite direction. A distended bladder should lie close up to the anterior parietes, a movable kidney deep on the posterior: but the slightest pressure for palpation may make the gall-bladder sink, while the intestines rise above it; and in a thin patient lying on her side, the intestines gravitating away from the right may leave the displaced kidney in contact with the parietes. If the parietes are not tense the liver may be fixed by pressing the hand under its margin to the inside of the gall-bladder, and then it may be found that it is impossible quite to make the gall-bladder disappear; while this makes no difference to the kidney. Repeated examinations in the lateral, supine, half-sitting and erect postures may be adopted in any case of doubt; and the diagnosis will be made, not by any single or special feature, but by a careful summation of all the features.

Tumours of the Omentum which get into the right hypochondrium are rare, and in my experience they are usually secondary to some

malignant disease elsewhere in the abdomen. They drift to the upper abdomen usually after the patient has taken to bed.

Growths of the Pylorus, malignant or innocent, may simulate movable kidney. The special symptoms of pyloric obstruction would in any case of doubtful diagnosis be absent or slight; in such a case the diagnosis would rest chiefly on the fact that a pyloric growth, if it does disappear from the palpating fingers, glides directly upwards, and not upwards and backwards as does the kidney. But it is rarely possible to make a pyloric growth disappear from palpation; and nearly always the symptoms of pyloric obstruction are present.

Growths in the Intestine, and especially in the large bowel at or near the hepatic flexure, may present physical features which are very similar to those of movable kidney. They may lie deeply, may easily be pressed under the ribs, and may have something of the size and consistence of kidney. If symptoms of stenosis of the gut are absent, and if the abdomen is deep and the parietes muscular, the diagnosis may be very difficult. Repeated examination in various positions will here also be the most certain method of making the diagnosis. Inflation of gas by the rectum may, in cases of growth in the colon, be of value in diagnosis.

Impacted Fæces may be mistaken for movable kidney. This element of doubt is easily removed by a purge. Fæces impacted at a seat of stricture may lead to more difficulty for a day or two; but the oncoming symptoms of obstruction soon clear up the diagnosis.

The objective signs are: tumour in the upper abdomen, of the shape, size, and consistence of a normal kidney, which, upon manipulation, slips away from the examining fingers, usually in the direction of its proper site in the loin. The patient will frequently draw attention to the tumour, and will explain that it changes its position. By comparison of the two loins, a want of resistance may be detected by the grasping fingers on the side to which the movable tumour tends to glide. The abdominal parietes being usually lax, this sign may be fairly definite : the laxity may be so great that the tumour may be bodily

grasped in the fingers, replaced in the loin, and there palpated in comparison with the opposite side. When handled in this way, the kidney will show a tendency to slip away from its situation in the loin; and this tendency may be encouraged by making the patient turn to the opposite side or stand upright. Its range of mobility is characteristic. Between the umbilicus and the side of the abdomen laterally, and between the ribs and the crest of the ilium vertically, the movable kidney may be moved, in varying degree, almost anywhere; but beyond the middle line, or into the pelvis, it will not go. The renal artery has been felt pulsating on its concave inner edge; but this is unusual.

Percussion gives little help. As intestine overlies the tumour, the note may be of normal resonance, or but slightly muffled. Increased resonance even, as compared with the opposite side, may be present in the loin.

During the physical examination, a subjective symptom of great value is elicited. This is a peculiar sickening and painful sensation, analogous to that experienced during compression of the testicle in man or the ovary in woman.

Indications for Operation. — Many cases of movable kidney require no treatment beyond a properly fitted abdominal support. Others, in spite of such support and of other palliative measures, are attended with great discomfort, or serious derangement of health. In a third class there is positive danger to life. This last class would include those cases in which there is present, along with the mobility, some inflammatory or degenerative condition, such as has already been described.

The indication to operate is the urgency of the case. The operation to be chosen is nephropexy. The most complete recent statistics are given by Keen.* Of 134 cases operated upon, 4 died. To this table might be added 16 more cases of my own, with no addition to the death rate. Probably 300 more cases might now be added to the above: but complete records have not appeared. Keen points out that at least three of these

* *Annals of Surgery*, Aug., 1890.

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deaths were attributable to preventible errors in operating; the mortality at its worst, therefore, is only about 2 or 3 per cent. The operation cannot be considered as absolutely free from danger. It is to be undertaken only after a full and fair trial of all known palliative measures, and at the desire of the patient.

Nephrectomy has been performed at least 30 times for movable kidney (Newman). Of these, 21 recovered and 9 died. For simple movable kidney, the operation is to be condemned; it is altogether an overdoing of surgical proceeding. But not all of these extracted mobile kidneys were healthy; at least 10 of them were diseased. Two were cystic, 2 contained calculi; these 4 recovered : of the others—1 containing pus and cheesy material, 1 sarcomatous, 3 encephaloid, 1 fatty, all died. There were 4 deaths among 20 excisions of healthy movable kidneys—a mortality of 20 per cent. It need scarcely be added, that nothing less than great danger to life, such as might occur from strangulation or diffuse suppuration, would justify the incurring of such a grave risk.

In the case of floating kidney, when nephrorraphy may be impossible, the negation of nephrectomy need not be so emphatic. Still, in this case, only failure of a patient and skilful attempt at fixation, and the continuation of grave and alarming symptoms, would justify the adoption of the major operation.

THE OPERATION.

The first recorded operation was performed by Dr. E. Hahn, of Berlin,* in April, 1881, and he gave it the name of nephrorraphy. He exposed the capsule of the kidney by an incision in the loin between the ilium and the last rib, along the edge of the sacro-lumbalis muscle. The perinephric fat was drawn into the wound, and sutured to muscle and fascia by half a dozen catgut sutures. Having found that after this operation the kidney broke loose, he recommended a more thorough proceeding by placing the sutures in the incised capsule proper, and fixing them to the superficial tissues.

* *Centralbl. für Chir.*, July 23rd, 1881.

Many variations on this mode of operating have been described, nearly all of them successful. Carrying the sutures through fat alone, through both fat and fibrous capsule, and through fibrous capsule alone; simple closure, with ordinary drainage; drainage by a large tube laid along the convex surface (Newman), so as to get a considerable growth of granulation tissue; packing of the wound by gauze or lint (Morris); incising and stripping back the capsule so as to get raw renal surface in contact with the surrounding parts (Law, Lane, Edebohls), and making it granulate from the bottom, have all been brought forward with the recommendation of success. In a case of mistaken diagnosis, where I opened the abdomen and found a movable kidney, I succeeded in fixing it by scratching its capsule freely with a needle pushed through the abdominal wall, while the hand inside the abdomen pressed it against the loin. Whatever detail in operating may be favoured, there is no doubt that the best plan of fixation is by extra-peritoneal incision through the lumbar muscles.

The best incision is an oblique one, as recommended by Bryant for lumbar colotomy. More accurately, it may be described as being parallel to the colotomy incision, an inch or less behind it, and rising as high as possible under the ribs. As this lumbo-renal incision will have to be frequently referred to, and as it is here performed under conditions most nearly approaching the normal, it may now be fully described.

The patient is placed on the side, resting on a hard round pillow, so as to increase to its utmost limits the costo-iliac space on the side of operation. The twelfth rib is located both by palpation and by counting. The top of the incision is fixed upon, at least half an inch below the last rib, and close to the outer border of the erector spinæ. It is continued downwards and forwards towards the crest of the ilium in a direction which the eye will suggest as the most convenient, according to the conformation of the body of the patient. The length ought not to be less than three inches. As the size and the shape of the ilio-costal interval vary greatly in different individuals, a fixed and definite line for the continuation of the incision cannot

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be laid down. Only the beginning of the incision can be fixed.

After dividing the skin and fat, the superficial fascia is exposed. A few cutaneous branches from the lumbar and the inter-costal arteries will be divided, and may require forci-pressure. The fascia being divided by the knife to the extent of the skin wound, the outer edge of the latissimus dorsi and the posterior border of the external oblique will be exposed. At this stage of the operation, I think it is best to lay the knife aside, and perform all further dissection by means of bent scissors. The latissimus dorsi being divided by cutting upwards and the external oblique by cutting downwards, the internal oblique and the transversalis will now be laid bare. The edge of the erector spinæ, to which is attached the fascia lumborum, need not be divided. The internal oblique and the transversalis aponeurosis are divided upwards and downwards by the scissors. Here branches of the lumbar arteries may be divided, and require forci-pressure. The outer margin of the quadratus lumborum is now exposed. The breadth of this muscle, and consequently the extent to which it encroaches upon the field of operation, is very variable. If it cannot be retracted, the encroaching fibres ought to be divided by a stroke of the scissors. Finally, the deep layer of the lumbar aponeurosis, often a dense and well-marked structure, is divided from end to end of the incision. This exposes the circumrenal fat, which probably bulges into the wound.

The dissection will, if deemed advisable, have been aided by the use of broad retractors in the hands of an assistant. The retractors are now made to gather up the whole of the divided tissues down to the fatty capsule, and the opening is stretched to its utmost dimensions. A second assistant pushes upwards and backwards the pendulous abdomen, and specially seeks to force the kidney towards the lumbar incision.

Two fingers, carried around the kidney and its capsule, now seek to diagnose the exact nature of the conditions associated with the mobility. If it is clear that the fatty tunic is closely adherent to the fibrous capsule, the former need not be opened.

But if the kidney has space for movement inside its fatty capsule, then this ought to be widely opened along the renal border, and the finger, inserted through this opening, moved freely over the renal surface, so as to excite plastic inflammation. In every case of doubt as to the exact nature of the mobility—and most cases will be doubtful—the free border of the kidney will be exposed by division of the fatty capsule. Aseptic irritation, such as would be produced by the exploring finger, is not only not harmful, but positively beneficial, as setting up an inflammation which may result in plastic adhesion. To facilitate cure as well as diagnosis, most surgeons would expose the free border of the kidney by division of the surrounding fat.

Several distinguished surgeons recommend that the renal capsule be stripped along the free border, so that additional strength and durability be given to the fixing adhesions. There can be no dispute that such a measure would, so far as fixation is concerned, be of real value. I have hitherto not stripped the capsule, because I fear the possibility of cirrhosis of renal tissue: if time shows that this risk is not incurred, I should certainly adopt stripping of the capsule as an adjuvant. Thus far, simple suture with perinephric irritation and removal of superfluous fat have given perfect results; progress of time may necessitate alteration of method.

The method recommended for fixation is as follows: The kidney is pulled well into the wound and is freed of fatty tissue all round down to the pelvis. Superabundant fat is removed by pinching and squeezing or by positive tearing. On the posterior surface all loose fatty tissue is cleared away and the kidney is made to lie on raw muscle. If the capsule is glistening all over, it is freely scratched with the finger-nail or with a blunt needle. Then sutures are inserted between the renal structure and the edges of the parietal incision. A special blunt needle of corkscrew shape is employed; and kangaroo tendon is perhaps the best suture material to use.

Two sutures are sufficient. As the kidney should be fixed well up under the ribs, these sutures should be placed in the lower half of the kidney. The sutures should be passed well into

the substance of the kidney, about an inch from the free margin.
When inserted, the free ends are drawn through the muscle at
the edges of the incision by means of pedicle forceps and tied
as buried sutures. The top suture is placed as high as possible
in the incision. Local irritation, with drainage, may be provided
by means of a large rubber tube placed along the kidney border.
This piece of tubing by some surgeons is not removed till
evidences of suppuration appear.

It is probable that permanency of cure would be more
certainly secured by general adhesions all around the kidney,
or by inflammatory condensation of its fatty surroundings, than
by the temporary and local adhesion produced by sutures.
Sutures are co-aptating, rather than uniting: they keep the
tissues in contact while they may adhere; they only to a slight
extent promote and secure adhesion. To the end of permanent
fixation, I should lay much stress on the stirring up of circum-
renal fat by finger or blunt instrument.

The closure of the wound and the after-treatment require no
special description.

Other methods of fixation have been described. One which
consists in transplanting a fibro-muscular band from the spinal
muscles and laying it in an incision made through the renal
substance I consider to be, in the face of the proved success of
the simple method described, an overdoing of surgery. The
tendency should be towards simplification, and not towards
complexity and elaboration.

Nephro-lithotomy.

By Nephro-lithotomy is meant the removal by surgical operation of a stone situated in the substance or the calyces or the pelvis of the kidney. No better definition of the operation can be given than that of M. Hévin,* enunciated a hundred and thirty years ago: "La Nephrotomie, ou plutôt, suivant Schurrigius, la Nephro-lithotomie, est l'opération par laquelle on extrait une ou plusieurs pierres au moyen d'une incision qu'on fait à la région lombaire, et qui pénétre jusques dans la cavité du bassinet du rein."

History.—Up to a very recent date, all operations upon the kidney were performed for stone: nephrotomy was practically synonymous with nephro-lithotomy. But, in most, if not in all, cases of ancient operation, cutting for stone in the kidney was as much the evacuation of an abscess, as the extraction of a foreign body. Hippocrates himself recommends incision for the removal of renal calculus, "should the parts swell and become elevated;" that is, if there is an abscess pointing. Neither Celsus nor Galen refer to the operation; so that we may conclude that it had not an assured position among the ancients. Arabian authors have casually referred to it. Turner, in his

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* *Mem. Acad. Roy.*, &c., tom. iii., p. 238. Paris, 1757.

Art of Surgery, published in London in 1727, quotes various writers to show that surgeons in very early times were familiar with lumbar nephrotomy. Avicen* says: "There are some who attempt to take the stone out of the kidneys by incision of the Ilea, but there is great danger therein." Cardan, lamenting over the number of lost operations that were common in the days of Hippocrates, mentions, among others, this one of removal of stones from the kidney. He quotes Albertus† as having met with a case where eighteen stones were removed from the loin of a woman who was long affected with nephritic illness. Caspar Bauhin reports the case of a girl who had an induration and swelling in the loin, from which a surgeon, after incision, removed two stones.

All these were probably cases of evacuation of an abscess, caused by stone ; certainly none of them were operations performed upon a kidney approximately healthy. The first case in which an operation is supposed to have been performed for the removal of stone from a kidney that was not suppurating is related by Mezerai, in his *Abrégé Chronologique de l'Histoire de France.* The doctors, says the historian, having learned that a certain archer of Meudon or Bagnolet, who had long been afflicted with stone in the kidney, had been condemned to death for his crimes, requested the magistrates to hand him over to them that they might experiment and see if it were practicable to extract the stone without killing him. The experiment was successful, and the man is said to have lived for several years in excellent health. This occurred about 1680. Paré, Sabatier, and others discredit this operation ; and we can scarcely give full credence to it. The mere record of it, however, shows that it was in men's minds, and regarded as within the bounds of possibility. Paré's unbelief or disapproval, it must be noted, is by no means disproof or condemnation : great as he was, he disbelieved in, or disapproved of, more than one operation which was both possible and sound.

The second case was the well-known one of Mr. Hobson, the English Consul at Venice, recorded in the *Philosophical*

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* *Canon.* lib. iii.   † *De Varietat,* lib. viii., cap. 44.

Transactions for 1696 by Dr. Bernard, to whom Mr. Hobson related his experiences ten years after operation. Some discredit has been cast upon this case also ; but I think there can be no reasonable doubt that the operation was performed, though it is just possible that suppuration existed. The case, related by the patient himself, who was not a medical man, is too circumstantial to be purely fictitious. The scholarly and accurate M. Hévin,* in his historical and critical researches into Nephrotomy, says that he saw and examined the fistula in Mr. Hobson's side, and fully satisfied himself as to the reality of the operation. In Hévin's paper is given a full account of the life and work of the Marchettis of Milan, one of whom performed the operation. I have elsewhere quoted my opinion as to the reality of this operation ; and Downes has contributed an able article to the same purpose.

The same amount of credence cannot be accorded to the case related by Joachim Camerarius,† in which a surgeon, at the urgent request of a nobleman who was suffering agonies, successfully extracted a stone that was plugging one of the ureters. Schurrigius,‡ using the case of a certain General de Birckholtz as a text, fully discusses the whole question under the name Nephro-lithotomy. In his case he would not operate, because he thought that the stones were blocking the ureter too low down to be within reach.

The practical outcome of these and other cases is fittingly summarised by M. Lafitte, in the second volume of the *Memoirs of the Royal Academy of Surgery*. He concludes that nephro-lithotomy is not to be reckoned as a justifiable surgical proceeding until abscess has formed. Rousselet and Riolan would remove a stone that could be felt. Nearly all subsequent writers admit the propriety of removing stones, provided abscess has formed ; and there is almost equal unanimity in condemning the operation in the absence of abscess. In the first volume of *Medical Essays and Observations*, published in Edinburgh in 1752 (p. 186), Mr. John Douglas relates how he attempted, after death,

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* *Mem. Acad. Roy.*, &c., tom. iii., p. 238, 1757.

† Schenck, *Observ. Med.*, lib. iii. ‡ *Litholog. Hist. Med.*, cap. 13.

to see whether it was possible to remove a stone that had been diagnosed to exist during life. He found that it was impossible. The depth of the incision was three and a half inches; and at this distance from the surface he found it impossible to reach the kidney substance. Such a record lends weight to the opinion that surgery, in some of its departments, has done nothing but retrograde for more than a thousand years; and that, in the last fifty years, we have done little more than pick up the clues that were lost when the Alexandrian Library was burnt.

There is no doubt that surgery is indebted to Mr. Henry Morris, of Middlesex Hospital, for the invention of the modern operation of nephro-lithotomy. He performed his first operation in 1880. Some hundreds of operations have been performed since then; but the operation of to-day practically continues as Mr. Morris left it.

RENAL CALCULUS.

Pathological Anatomy.—Renal calculus occurs chiefly before the age of fifteen and after fifty. According to Mr. Thomas Taylor, quoted by Morris, each age has its variety of calculus: "The nucleus of renal calculi formed in infancy is urate of ammonia; the nucleus of calculi formed in adult life is uric acid; whereas that of calculi formed after the fortieth year is oxalate of lime." Whatever its nature, and wherever it originates, the calculus usually rises to pathological and clinical importance in a calyx, or in the pelvis, or in the upper extremity of the ureter. One or both kidneys may be affected with lithiasis; and one or more stones may be found. The amount of mischief set up varies according to the size of the stone, the roughness or smoothness of its surface, and the position it occupies. A very rough stone, as one of oxalate of lime, may lie quietly in a calyx for years; while a small rounded smooth stone, which has not escaped from the secreting substance, may set up inflammation or suppuration. A small stone in the pelvis which just fits the orifice of the ureter may, by preventing the outflow of urine, cause most mischief of all.

Three types of nephro-lithiasis may be pathologically differ-entiated. The first is the small stone, with healthy renal tissue. The second is the large, perhaps branched, stone, coated with phosphates, and lying in an abscess-sac the walls of which are the thickened and suppurating calyces. The third is the small movable stone, blocking the ureteric orifice, and causing hydro- and pyo-nephrosis, with destruction of renal tissue. Each type has its special clinical features ; and for each a variation in the operative procedure is called for. Strictly speaking, these types are different stages or casual developments of the same disease ; but they are sufficiently marked to be worthy of differentiation.

(1) Gravel formed in the uriniferous tubules may either pass away in the current of urine without causing symptoms ; or may, after increasing in size, be passed with difficulty along the ureter, producing symptoms of renal colic ; or may remain embedded in the renal tissue, or imprisoned in a calyx. Here it may remain for long periods, setting up symptoms indica-tive of irritation rather than of inflammation, or pathological degeneration. Physically, it may cause bleeding, and set up attacks of renal congestion or inflammation, which spontaneously subside ; physiologically, it begets a long train of symptoms, referable chiefly to the influence of nerve connection.

(2) In the calyces or the pelvis, a stone may set up catarrh or inflammation of the lining membrane, with secretion of pus, which passes into the bladder with the urine. As the stone grows the calyces are dilated, while their walls are thickened ; accretion takes place in the areas where pressure is least, and the stone thus comes to be a cast of the dilated calyces which it occupies. The stream of urine flows along between the stone and the encircling sac ; there is no urinary obstruction ; and renal tissue is destroyed by continued suppurative inflammation, set up by the foreign body. In this way a renal calculus may attain to enormous dimensions, without causing marked symp-toms. In the museum of the Bristol Infirmary is an enormous stone, which is a perfect cast of the calyces and lobules of a kidney enlarged to four times its normal dimensions : this stone was accidentally discovered at the post-mortem examination of

a patient who died of lung inflammation, and who had presented no sign of renal calculus. Sometimes the calculus rolls about in an abscess sac of its own formation, and increases in size in the pelvis or calyces in the same manner as a vesical calculus. Suppurative inflammation spreads by continuity of tissue to the renal substance, and will ultimately cause its complete destruction. The further course of this process is towards the formation of peri-nephric abscess, which may burst through the loin, forming urinary fistula.

(3) When a comparatively small stone rolling about in the pelvis becomes engaged in the orifice of the ureter, acting as a sort of ball-valve, the outflow of urine is checked, and, in addition to calculous pyelitis, there is set up an atrophic degeneration of the kidney, which may ultimately leave it as a loculated sac, containing very little healthy secreting substance. In the fully developed condition, numerous cavities are found containing brown putrid urine, with numerous calculi ; and in the bottom of the pelvis, or lying in the orifice of the ureter, is found one stone which is presumably the source of the mischief. The renal tissue is not destroyed by advancing suppurative inflammation, but by compression and distension, brought on by obstruction to the flow of urine.*

Many varieties of calculus are formed in the kidney. The most common is uric acid ; next in frequency comes oxalate of lime. Other varieties are composed of phosphate of lime, carbonate of lime, the triple phosphate, urate of ammonia, cystine, and xanthine. Occasionally the nucleus is formed of a blood-clot, or a fibrinous coagulum. Indigo has been found in the centre of a renal calculus ; the uro-stealith, or "soap-stone," is very rare.

Symptoms and Diagnosis. — Both kidneys are about equally liable to calculus ; in about a fifth of the cases, stone exists simultaneously in both organs. It is more common in males

* Jordan Lloyd (*Practitioner*, Sept., 1887) has brought his extensive experience and study to bear on the further elaboration of these types, mainly from the clinical and practical standpoints. To his paper I would refer my readers.

than in females, and is most frequently found to arise before middle age.

A stone in the kidney will probably first signify its presence by pain and hæmorrhage. Sometimes the symptoms are slight and transient; frequently they are exceedingly severe and persistent, so much so as almost to make life unbearable. Other symptoms associated with the pain and hæmaturia are gastric disturbances, retraction of the testes, irritability of the bladder, pus in the urine, and sometimes suppression of urine.

The pain is usually felt in the loin, over the kidney affected; though it may be felt in both loins, while one kidney is healthy. It is of a dull, heavy, dragging character, and may shoot downwards along the course of the ureter, and be referred to the testicle or even to the point of the penis. Sometimes it may shoot down the thigh, and be specially referred to the leg, the sole of the foot, or even the knee. Apart from the actual pain, there is sometimes a curious feeling of consciousness in the patient's mind as to the existence of a stone in the kidney. Some tenderness on pressure over the affected kidney is usually confessed to. The pain is intermittent, and is usually at its worst after active or jerking movements. Posture may affect it. Thus, a patient who suffers while sitting may be relieved by walking or lying down; pain which may be severe while the patient lies on one side, may be relieved by his turning on to the other; and various other positions, known from experience, may afford comfort.

Symptoms referred to the testicle of the diseased side, when they exist, are characteristic and valuable. Peculiar sensations, varying from tenderness to actual pain of a neuralgic character; some degree of swelling, and retraction of it within the scrotum, are the most common concomitants of calculus. In the female such pain may be referred to the labium, or the orifice of the urethra.

Symptoms derived from the bladder and urine are common. Vesical irritation is a common symptom of renal calculus. In fact, so common is it, that patients under close observation are usually sounded for stone before the diagnosis of renal calculus

is made. There will be a constant desire to pass water, with frequent passing of it. Hæmaturia, remittent and not very profuse, is very frequently associated with the complaint. Occasionally it is absent throughout the disease. Sometimes it is present only after exercise; if it exists at other times, jarring motion is almost certain to aggravate it. As found in the urine, the blood is mixed less intimately than it is in other diseases of the kidney, and more intimately than in disease of the bladder or prostate. Casts of the ureter are occasionally found, and sometimes small rounded clots. Pus may be found in the urine from pyelitis that may have been set up. A probable guess as to the nature of the stone, its roughness or smoothness, may be made from the amount of the bleeding.

Symptoms referable to the stomach are not uncommon. There may be nausea, vomiting, and irregular attacks of indigestion, accompanied with flatulence and colicky pains.

A presumptive evidence of stone in the kidney is a previous history of renal colic, arising from the passage of stone along the ureter. If the kidney has formed a stone once, it may do so again. Such an attack once borne, is a memory for a lifetime. The acute agony of pain in the loins, shooting down the ureter into the testicle; the depressing nausea and ineffectual vomiting; the persistent vesical tenesmus, and the final exacerbation as the stone passes the narrow channel before entering the bladder, make up a combination of suffering as intense, perhaps, as disease can create. If renal colic has existed, the patient is sure to know of it.

A stone has actually been felt in the kidney by the examining finger, and a sensation of grating has been communicated by the rubbing of several stones together. But such an aid to diagnosis is very rarely afforded. Strong pressure or a sharp squeeze, as causing an increase of pain of a pricking or stabbing character, may be of great diagnostic value.

As a result of extensive and carefully elaborated clinical experience, Bennett May* groups cases of stone in the kidney into three classes: (1) Where pain is the only prominent

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* *Birm. Med. Rev.*, Jan., 1887.

symptom—that is, where no help is given to the diagnosis by the physical examination of the urine or the patient, though constitutional symptoms may be present. (2) Where pus or blood, or both, are found in the urine. (3) Where, in addition to any of the above, there is a lumbar swelling or tumour in the region of the kidney. This, it will be seen, runs in some respects parallel with the division given above from the pathological point of view. In women, according to this authority, hæmaturia may be more misleading as a symptom of stone in the kidney than in men; a peculiarity which may depend on the fact, pointed out by Lloyd, that in women the primary and secondary tubes are long and narrow, and therefore more likely to closely encircle the stone.

An element of confusion arises in the fact, first noted by Thornton and confirmed by others, that stone on one side may produce symptoms on the other. Godlee* relates a very interesting case where, after a stone had been removed from the right kidney, there was severe colicky pain on the left side, followed by the discharge of several small fragments of stone.

. The differential diagnosis has to be made with malignant and villous growths of the bladder; purpura and hæmophilia; and malignant or inflammatory disease of the substance of the kidney. In addition to the symptoms already detailed, the profuse hæmorrhage of the first, with abundant clots and imperfect commingling of blood and urine, will help us. For the rest, the existence of the characteristic dyscrasiæ, and, in the case of tumours, the presence of a swelling in the renal region, will help us. Hæmatinuria will be recognised by its characteristic symptoms, borne out by a microscopic examination of the urine. The condition most likely to be mistaken for renal calculus is early strumous disease of the kidney. The presence of pain in calculus, and the absence of hæmaturia in strumous disease, are the chief signs relied upon for diagnosis. I have on two occasions (once with the assistance of my colleague, Dr. Shingleton Smith) diagnosed strumous kidney from the discovery of tubercle-bacilli in the urine.

* *Practitioner*, Oct., 1887.

An attempt to diagnose the actual pathological condition present ought to be made.

The small calculus with healthy kidney may be suspected when the symptoms are chiefly or entirely hæmaturia and pain.

The large calculus embedded in an abscess-sac is suggested by pus in the urine, a tumour or increased resistance in the loin, and pain on pressure.

The hydro-nephrotic kidney, with small calculus blocking the ureter, is suggested by repeated attacks of lumbar pain, alkaline or putrid urine containing little pus, and a variable swelling in the loin, which is not very hard, and not very painful on being pressed.

Every surgeon can quote from his own experience diagnostic surprises in connection with nephro-lithiasis. On the same day at the Bristol Infirmary I recently performed nephro-lithotomy on two patients, removing oxalate of lime calculi weighing about 100 grs. in each case. One patient was sent in as relapsing appendicitis; and although I suspected renal calculus, I began by exploring the appendix vermiformis to find it healthy. The other case had only severe pain in the back. From a third patient, about the some time, I removed from a shell of kidney a stone weighing over six ounces; at death six weeks later, this shell was found to be a pure cancer. In a fourth coincident case a peculiarly complete series of symptoms of stone in the kidney led to an exploratory operation, in which nothing was found; the patient died of urinary suppression (the only death I have had from this operation) and nothing was found post mortem. These surprises in renal surgery we must expect; we do not know how to avoid them; as a *per contra* we may legitimately point to a highly gratifying degree of success in the operation for removal of stone from the kidney.

Indications for Operation.—Dickinson tells us, that of three individuals who have stone in the kidney, only one dies of it; the other two die of something else. The mere presence of stone in the kidney is not, therefore, an indication for operation. We must, in the first place, wait to see if the stone will be

passed by the ureter; and, in the second place, come to a decision, either that the calculus is setting up mischief in the kidney which may endanger life, or that the subjective symptoms are so urgent that necessary work cannot be performed or health is being undermined. In every case, palliative treatment by rest, the exhibition of alkaline drugs, and careful dietary, will have been fully and fairly tried. Morris makes the wise suggestion that, when anuria follows symptoms of calculus in both kidneys, the kidney which has last become affected should be first explored.

A further reason for caution in proceeding to operate is the fact, that in a considerable proportion of operations, probably in about one-fifth, no stone is found. This, of course, is no reproach to the operation itself; it is simply a result of the fact that exploration and operation must go together. We cannot in the kidney as in the bladder prove the presence of stone by sounding before proceeding to operate.

Where the kidney is diseased, the indication is to operate at once, provided the other kidney is diagnosed as healthy. In such a case, the operation may be little more than a simple nephrotomy, with drainage of an abscess. If advanced suppuration exists, the question of nephrectomy will arise, and must be decided on the same principles as would guide us in operating where there was no stone. In many cases of suppurative nephritis, stones are found which may have little connection with the origin of the disease. Barker points out that, in advanced calculous disease, both nephro-lithotomy and nephrectomy are about equally dangerous, as the patients are usually advanced in years and much pulled down in strength. Nephro-lithotomy, where the kidney is healthy, is a very safe operation: as yet, its mortality has not exceeded 10 per cent. Of 21 operations collected by Gross, 2 died—a mortality of 9.52 per cent. Newman has collected 42 operations on healthy kidneys without a death. These do not include 9 operations of mine, with 1 death (where the kidney was cancerous) at the end of six weeks. At least 100 operations have since then been performed. He finds that Brodeur (possibly Gross also) included cases in which suppu-

ration existed. Where suppuration was present, 60 operations were followed by 26 deaths—a mortality of 43.3 per cent.

THE OPERATION.

Instruments.—Besides the ordinary instruments for making the parietal incision, certain special instruments for exploring the kidney and removing calculi are required. To keep the wound open Morris's retractors (Fig. 190) will be found very useful. For exploring the renal substance a fine conical needle set in a handle is essential: the stiletto invented by Clement Lucas for this purpose (Fig. 191) is recommended. His blunted lance (Fig. 193) and lance forceps (Fig. 194) for tearing or scratching through renal tissue to reach a stone should also be at hand, as should be his forceps (Fig. 192) for removing a calculus.

Other instruments which might be wanted are Jordan Lloyd's exploring sound, of shape and size similar to the smallest bladder sound for children; and Morris's strong forceps, like sequestrotomy forceps, for breaking up a stone which cannot be removed entire. Ordinary lithotomy scoops should also be provided. Irrigation apparatus to wash out fragments from loculi should be included in the surgical armamentarium.

FIG. 190.

Morris's Retractor.

FIG. 191.

Clement Lucas's Stiletto.

The best *incision* is the oblique lumbar one recommended for nephropexy. Morris favours this incision: Howse made use of a vertical incision, supplemented by a transverse one; and other surgeons have variously modified

it. The knife is entered close to the edge of the erector spinæ, half an inch or more from the lower border of the twelfth rib, and carried obliquely downwards and forwards towards the crest of the ilium for three or four inches, according to the size and shape of the costo-iliac space. If, in spite of the artificial enlargement of the costo-iliac space by the pillow placed under the opposite loin, the area for operation is very limited, the incision may be curved forwards, after being carried farther back than usual. Additional space may be got by dividing transversely the fibres of the quadratus lumborum. With the division of the deep lumbar aponeurosis and the exposure of the circumrenal fat, this preliminary stage of the operation is finished. All pressure forceps are now removed, vessels of considerable size being ligatured, and the wound is made to gape as much as possible by retractors in the hands of an assistant.

The fatty capsule is teased open with forceps, and the kidney surface is exposed. Morris says that, as the back of the kidney is approached, there may be noted differences in the character of the fat; that next the kidney being of fine texture, and of a delicate primrose colour. If there has been long-standing inflammation of the kidney, the surrounding tissues will be abnormally firm and coherent.

FIG. 192.

Lucas's Kidney Forceps.

FIG. 193.

Lucas's Kidney Lance.

Through the opening thus made in the fat the finger is

54 *

pushed, and the surface of the *kidney is systematically explored*.
During this examination, an assistant, pressing on the abdominal
surface, forces the kidney as much as possible
into the wound. The anterior surface may
be explored while the kidney is lying on the
psoas, against which firm surface it is pressed.
To explore the posterior surface, the kidney
is pulled forward and compressed against
either a broad spatula or the fingers of the
opposite hand. Lange's proposal, to examine
the pelvis by tilting forward the whole organ,
is well worthy of attention. (Fig. 195.)
It is certainly easier to examine the kidney
between the fingers when it is well pulled
forwards out of its bed, than when it is lying
far back in its normal situation. Every particle
of renal
tissue is
rubbed and
squeezed
between
the fingers,
and any
hard spot is
noted. If
the stone
is small,
and if it is
overlapped
by renal tissue, which may
be increased in density from
prolonged irritation, it may
be impalpable. In one case
of Morris's, after the kidney
had been removed and placed
on a table, it was found impossible by palpation with the finger
to detect a stone which was embedded in a calyx. Of this

FIG. 194.

*Lucas's Renal
Lance-forceps.*
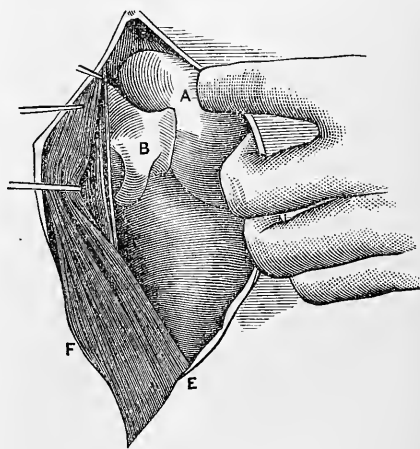
FIG. 195. (LANGE.)

*Pelvis and Ureter exposed from behind after
removal of Peri-nephric Fat.*

A, Kidney; B, Pelvis of Kidney; E, F, Quadratus
Lumborum.

fact there can be no doubt : a most painstaking examination with the finger may fail to detect a stone where it is present.

Should a hard or elevated area be made out, the exploring needle is pushed into it, and the stone felt for.

Should no stone be felt, the plan recommended by Jordan Lloyd * should now be adopted.   As a result of his anatomical studies (see above) and practical experience, he considers it infinitely more reliable and quite as easy to execute as the ordinary plan of needling.   "The procedure is analogous to the method of detecting stone in the bladder, differing from it only in the one particular, that we reach the kidney's interior through an opening artificially made.   When the kidney is exposed through a lumbar wound, I puncture its lower end with a long-bladed tenotome in a direction upwards and inwards, making for the lowest of the calyces.   If the surgeon is observant and his knife is keen, he will readily appreciate the moment when a cavity is struck by the altered resistance offered to the puncturing instrument.   .   .   .   Into this opening I pass a child's bladder sound, and systematically explore the whole interior of the pelvis. This sound should be of special construction, having a beak not more than one-third of an inch in length, a stem about seven inches, and the size of a No. 3 English catheter.   It should be passed at once to the top of the kidney cavity, a distance of nearly four inches, and the exploration should be carried out systematically, from above downwards, the point being rotated in all directions so as to investigate both tubes and calyces as the instrument is withdrawn."   He has succeeded by this plan, after needling and palpation have both failed.

Should this plan fail, a systematic examination with exploring needle may be carried out.   This needle is a fine sharp steel probe, mounted on a wooden handle.   (Fig. 191.)   It is so fine that it makes a very small wound ; and, being only two and a half inches in length, it cannot, if pushed through the cortex, wound the large renal vessels.   The exploratory punctures are made in a thoroughly systematic manner from one end to the other of the posterior border.   While this is being done with the

* *Loc. cit.*

needle in one hand, the kidney is steadied and held upwards in the wound by the fingers of the other hand. Every thrust ought to be towards the hilum, so as to strike the position of the calyces. Should the needle strike a stone, a long thin-bladed knife is pushed alongside of it, till it also strikes the stone, and a vertical incision is then made in the renal tissue through which the stone may be extracted.

Supposing that no stone is discovered after complete exploration with the needle, the operation is not to be abandoned. The kidney may be unhesitatingly laid open by an incision along its posterior border, long enough to permit of digital examination of the calyces. As Morris remarks, " kidney wounds are known to heal readily, and whilst the risk of such an incision would not equal that of nephrectomy, the subsequent condition of the kidney would be preferable to the possession of only one of these organs." Instead of the finger, a sound, such as that of Lloyd or Lucas or Bruce Clarke,* may be used. The latter surgeon made a series of careful experiments in the post-mortem room, to test how far it was possible to explore with a flexible sound the various recesses of the kidney. He found that with an ordinary bougie *à boule* with a porcelain tip it was possible to explore nearly every part of the pelvis and calyces.

Supposing a stone is felt in the pelvis of the kidney, it may become a question whether it would not be better directly to extract it by incising or tearing the pelvis, than to do so by incising the renal tissue. The pelvis should be opened from behind if possible, and the instrument used ought not to be sharp. After opening the pelvis, there is a risk of urinary fistula; therefore, wherever it seems feasible and proper, extraction should be made through an opening in the renal tissue.

The first incision down to the stone is made large enough to admit the forefinger. An attempt is made to raise up the stone on the finger-pulp, and this manœuvre may be assisted by a small scoop. The opening, if not large enough, is increased by tearing and dilating. Hæmorrhage is controlled by the finger, acting as a plug, and is rarely troublesome. It is always advisable

* *Surgery of the Kidney.* London, 1886.

to remove the stone entire, if this can be done without injuring the secreting substance; otherwise, it must be broken up. Bennett May has succeeded in removing entire from a kidney but slightly enlarged a stone an ounce in weight; and at least one heavier has been extracted. I have removed, in fragments, a stone weighing over six ounces in weight.

The removal of a calculus blocking the orifice of the ureter may be an affair of extreme difficulty, taxing to the full the manual and mental resources of the surgeon. I have assisted at such an operation in which most skilful and persevering efforts on the part of one of our most brilliant operators only succeeded after an hour's trial in removing the stone.

Where the kidney is suppurating, and the stone lies in an abscess sac, the operation may be very easy. On the other hand, as in large branched calculi, it may be impossible to remove the stone until it has been broken into fragments. Each case must be managed on its own merits: a resourceful surgeon will at once decide upon the most favourable plan of removing the calculus.

A drainage-tube is placed in the bottom of the parietal wound, behind the kidney: the wound itself is closed in the ordinary way by deep and superficial sutures. For the first day or two nearly all the urine escapes by the drainage-tube: it soon diminishes, however; and after a few days or weeks, ceases altogether. To prevent contact of the urine with the wound, an attempt ought to be made to convey it into a reservoir. This may be done by using ordinary imperforated rubber tubing, making holes in it only for the distance it extends into the tissues, and carrying the external imperforated portion into a rubber bottle which lies at some distance from the patient. The tube should be fixed in the opening by a stitch including the tube and the skin. The wound is dressed with ordinary absorbent material: it usually heals with great rapidity.

Of special dangers following nephro-lithotomy we know little; for they have not yet appeared. If hæmorrhage is troublesome, a catgut suture may be carried through the renal tissue, so as to exert compression. Cellulitis, renal abscess, and renal fistula, are mentioned as possible results by Morris. In cases of advanced

calculous pyelitis, the dangers are practically those of nephrotomy or nephrectomy for the same condition. The question as to the advisability of combining coeliotomy with lumbar section is but little different, in calculous disease, from that presented in non-calculous disease, and need not specially be considered here.

Puncture of the Kidney, and Nephrotomy.

By Nephrotomy is meant the operation of making an incision into the kidney, for the purpose of evacuating cystic or purulent collections of fluid. Puncture of the kidney is simply nephrotomy done without dissection, and not followed by drainage; nephrotomy is usually preceded by careful dissection through the loins, and is nearly always followed by drainage.

Puncture, nephrotomy, and nephrectomy overlap. Any one of them may be indicated for the same condition; and, indeed, all of them may properly be performed in succession for the cure of this condition. Thus, in a case of hydro-nephrosis puncture failing to cure, nephrotomy with drainage may be tried; if this also fails, nephrectomy may be performed. Beginning at the other end, nephrectomy as a primary procedure has a more limited application. It is admissible where puncture and incision are inadmissible, only in the case of new growths; in every other condition, and especially in cysts and abscesses, it may properly follow a want of success in the minor operation of nephrotomy.

It is undoubtedly the case that for the same disease—scrofulous kidney, for example—nephrotomy or nephrectomy may be performed with equal propriety. But the actual stage or condition of the disease ought to be very different for each operation. It is impossible, therefore, to classify the indications for operation under the heads of the pathological condition for which the operation may be performed. It will serve our purpose of description better, and at the same time emphasise the best recognised practice, if under each operation we consider only such diseases as directly and specially call for it. For some of them, puncture ought first to be performed; if this fails, nephrotomy ought to follow; if this also fails, nephrectomy may be called for. In others, the first proceeding ought to be nephrotomy; if this fails, nephrectomy may be demanded. Nephrotomy also may sometimes be regarded as preparatory to nephrectomy. In a third class, nephrectomy ought to be performed at first.

The following classification may be adopted as practically convenient :

Renal Puncture, indicated in—

    (1) Simple cysts.

    (2) Hydro-nephrosis.

    (3) Hydatid cysts.

Nephrotomy, indicated in—

    (1) Cases where puncture fails.

    (2) Pyo-nephrosis.

    (3) Suppurative nephritis and pyelo-nephritis.

    (4) Scrofulous kidney.

    (5) Calculous suppression of urine.

Nephrectomy, indicated in—

    (1) Cases where nephrotomy fails, or would evidently be useless.

    (2) Certain new growths of the kidney.

    (3) Ureteral and renal fistulæ.

    (4) Serious wounds of the kidney.

    (5) Disease or degeneration of movable kidney.

Puncture of the Kidney.

Conditions requiring Operation.
Simple Cysts of Kidney.
Para-nephric Cysts.
Hydatid Cysts.
Hydro-nephrosis.
Operation Described.

CONDITIONS FOR WHICH THE OPERATION MAY BE PERFORMED.

Puncture of the kidney may be employed in any form of renal cystic enlargement; but it is primarily indicated as a curative measure only in simple and hydatid cysts, and in hydro-nephrosis.

Simple Cysts of the Kidney.—Here we are not concerned with those small cysts so frequently found in granular kidneys; nor with the rare general transformation into numerous cysts found congenitally or in adults. The former never attain to surgical dimensions; the latter, general cystic degeneration, being bilateral, is not amenable to surgical treatment.

Simple serous cysts are found as thin-walled, globular tumours, of varying dimensions, springing from some part of the renal cortex. Their contents are not urinous, but a pale straw-coloured fluid, of low specific gravity, containing a considerable amount of albumen. Sometimes the cavity of the cyst communicates by an opening with one of the calyces; most frequently it is blind. The fluid often contains cholesterine, and occasionally blood. Rarely the contents are thick, or of the consistence of jelly.

These cysts are harmful only when they attain to large dimensions. They tend to distort, spread out, and cause atrophy of the proper renal tissue, as well as to interfere with health, from their bulk.

The symptoms are simply those of a slowly growing cystic tumour, situated in the loin. There are no special signs available for diagnosis. Urinary symptoms are absent; and there is no pain, or pyrexia, or evidence of ill-health. Diagnosis can be made only by exclusion of other forms of cystic enlargement.

Para-nephric Cysts are rare developments of doubtful origin, which arise in the tissues immediately surrounding the kidney, and sometimes form a connection with it. They may be congenital. Clinically, they are indistinguishable from simple cysts; practically, their recognition is unimportant, as the treatment is identical.

Hydatid Cysts of the Kidney.—Hydatids are found in the kidney six times less frequently than in the liver. In a considerable majority of cases, the left kidney is the organ affected; very rarely are both organs affected at once.

The cyst usually originates in the secreting substance; but

it occasionally develops in the cellular tissue underlying the capsule or surrounding the pelvis. The renal tissue is thinned out and atrophied, from pressure. As compared with hydatids of other organs, renal hydatids do not attain to very large dimensions; this is probably due to a tendency which they have to discharge a portion of their contents through the ureter. Of 63 cases of renal hydatids collected by Roberts, a history of vesicles passed in the urine occurred in 52. A renal hydatid cyst containing four pints of fluid would be considered a large one. It may burst into surrounding organs, as the intestine or lung; and it may undergo any of the inflammatory, degenerative, or atrophic changes which are found in hydatids elsewhere. Hydro-nephrosis has been caused by the impaction of a vesicle in the ureter.

The symptoms of renal hydatid disease are: the passage of hydatid vesicles in the urine, preceded by attacks of renal colic; and the existence of an abdominal tumour, fixed in the loin. Sometimes there is a discharge of hydatids, and no tumour; more rarely is there a tumour, and no hydatid escape. In only 18 of Roberts's 63 cases was a tumour discernible. Fluctuation is not always perceptible; and the hydatid fremitus is as rarely observed here as in the liver or elsewhere. The vesicles are found entire or ruptured; occasionally nothing is found in the urine but hooklets and shreds of membrane. Blood or pus may be discharged with the hydatids: these are specially frequent after attacks of renal colic. Retention of urine has been caused by blocking of the urethra; and, as already remarked, hydro-nephrosis may arise from blocking of the ureter. In the bladder, the vesicles may beget symptoms of irritation or tenesmus, or even inflammation: impacted in the ureter, the vesicles may set up the train of symptoms already described as characteristic of renal colic, from the passage of calculus.

Hydro-nephrosis.—This is a distension of the kidney with fluid, caused by an obstruction to the flow of urine. The obstruction may exist at any point in the urinary tract—urethra, bladder, ureter, or pelvis of the kidney. It may be congenital or acquired.

According to Morris, about one-third of the cases have a congenital cause; but in some cases this cause does not have its full effect in producing hydro-nephrosis till late in life. "Congenital nephrosis" must not be confounded with "hydro-nephrosis having a congenital cause."

Congenital causes of hydro-nephrosis are numerous and various. In the ureter, twists, kinks, reduplications or folds, stenosis, and complete obliteration, have all been described as causes. The junction of the ureter to the kidney or to the bladder may be faulty, obstructing the flow of urine. Compression of the ureter by abnormal arteries has been described as a cause of hydro-nephrosis.

Of acquired causes, the most important, from a surgical point of view, is impaction of a calculus in the ureter or pelvis of the kidney. In an elaborate investigation into the causes of 142 cases of marked hydro-nephrosis extracted from the post-mortem records of Middlesex Hospital, Morris found that 116 cases had cancer of the pelvic organs, uterus, vagina, bladder, or rectum; 2 had cancer of the ovaries; and the remaining 24 had, in about equal proportions, cystitis, vesical calculus, enlarged prostate, ovarian cyst, constriction of ureter, cancer of abdominal organs: in one there was a villous growth of the bladder; in 4 the causes were unknown. Roberts found in 32 cases of hydro-nephrosis the causes to be—impaction of calculus in the ureter in 11, and probably in 3 more; in 5, cicatricial stenosis of the ureter; in 6, compression of the ureter by pelvic tumours; and in 3, compression by inflammatory peritoneal bands. Retroflexion of the uterus has been described as a cause; and Morris and James have explained how greatly increased frequency of micturition may produce hydro-nephrosis. The most elaborate investigation into the causation of acquired hydro-nephrosis has been carried out by Newman.* Of a total of 665 cases, tumours of the pelvic organs causing pressure on the ureters were the causes in 184, stricture of the urethra and enlarged prostate in 234, tumours or abscesses of pelvic organs leading to torsion of the ureters in 32, renal calculi in 68,

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* *Surg. Dis. of Kidney*, 1884, p. 114.

displacements of the kidney in 17, tumours of the bladder in 10, and bands and adhesions in 12.

Hydro-nephrosis is about equally common in both kidneys; in about one-third of the cases it exists in both at the same time. It is found at all ages, and with equal frequency in both sexes. From an analysis of 69 cases of hydro-nephrosis and pyo-nephrosis, Dickinson concludes that death from one or other of these closely-allied complaints "is especially frequent during the first ten years of life, as the result of congenital lesions; as an acquired disease, largely due to stone, it produces its fatal issue with increasing frequency up to 50, beyond which age it is seldom delayed."

As to the actual lesion produced, it may affect the whole kidney, or only part of it; that is to say, the distension may involve the whole pelvis, or only a few of the calyces. A case has been recorded in which a tumour of considerable size was caused by the distension of one calyx. The mode of distension is easily understood. The pelvis is first converted into a globular sac; the calyces then become dilated; and lastly the medullary and cortical portions are stretched out and thinned. In extreme cases, the secreting tissue may be represented by a thin layer underlying the capsule; or all traces of it may disappear, and the kidney then is little more than a cyst with thin fibrous walls subdivided internally into secondary cysts or saccules by complete or incomplete septa. In most cases some trace of secreting tissue remains, with something of the kidney shape. In size the sac varies from that of the normal kidney, or less, to dimensions sufficient to fill the abdominal cavity. In only a small proportion of cases, however, does hydro-nephrosis attain to a size sufficient to cause perceptible tumefaction of the abdomen.

The fluid in the cyst is never pure urine; frequently it contains neither urea nor uric acid. It is usually a simple, clear, aqueous fluid, of low specific gravity, containing a little chloride of sodium and perhaps albumen. Occasionally the fluid is brown, from admixture with blood; rarely it is thick or colloidal; and sometimes it is putrid, ammoniacal, and turbid.

It has been pointed out that the obstruction in the most

typical cases of hydro-nephrosis is not complete and not con-
tinuous. A complete obstruction to the urinary flow leads to
atrophy, rather than to dilatation of the kidney; stricture, varying
in narrowness, predisposes to dilatation. A calculus in the pelvis
or the ureter, occasionally moving, causing at one time partial, at
another time complete obstruction, while it sometimes moves out
of the way altogether, provides the ideal cause of hydro-nephrosis
such as comes up for surgical treatment.

Symptoms of hydro-nephrosis, in the absence of a tumour,
are usually wanting altogether; in the worst cases there may be
symptoms of urinary suppression. In disease of both kidneys,
uræmia sooner or later appears. Diagnosis is possible, or rather
probable, only when a tumour is present. Such a tumour is
rounded, often lobulated, usually fluctuating, and lies mainly in
the loin. If the tumour is very large, it may occupy and
distend the whole abdomen, on one side as much as on the
other; in such a case, a history of its having once been one-
sided, or of its having appeared in the costo-iliac interspace,
will be of assistance. In every case, a history of its varying in
size is of importance—almost pathognomonic, in fact. Morris
has recorded eleven cases where the tumour completely inter-
mitted; that is, where it was prominent at one time, and not
distinguishable at another. Many others show temporary
diminution without actually vanishing. If, with the diminution
or disappearance of the tumour, there is observed an increased
flow of urine of low specific gravity, we may almost certainly
diagnose hydro-nephrosis.

As to subjective symptoms, records are extremely variable.
Frequently there is no pain whatever; sometimes there is severe
pain, occasionally amounting to agony. The amount of tension
and the presence of a calculus would influence the production
of pain.

The diagnosis of hydro-nephrosis is often difficult, sometimes
impossible. It may be mistaken for any cystic abdominal
tumour. Of renal cystic enlargements, it is most liable to be
confounded with simple or hydatid cyst, and with pyo-nephrosis.
In hydatids the history gives most important aid. In pyo-

nephrosis, elevation of temperature with continuous or occasional presence of pus in the urine, may be expected. Hydatids of liver or spleen may mislead. But, when the tumour is large, it is most frequently mistaken for ovarian cystoma ; at least fifteen cases are on record in which hydro-nephrotic or simple renal cysts have been mistaken for ovarian tumour, and coeliotomy performed on the erroneous diagnosis. (Morris.)

THE OPERATION OF PUNCTURING THE KIDNEY.

This operation may, with a fair promise of cure, be performed for any of the above conditions; viz., simple cyst, hydatid, and hydro-nephrosis. In the case of simple cysts, tapping may be repeated several times should the cyst refill. In hydatid disease, tapping may be successful, and should be tried ; but incision, with drainage, is likely to be called for. If there is no discharge of vesicles by the urethra, Morris considers that the only proper treatment is nephrotomy. The first proceeding, in all cases of hydro-nephrosis calling for treatment, ought to be tapping. Friction and compression by the hands have caused several hydro-nephrotic tumours to disappear ; but in few cases can manipulation be entirely free from risk, and in the great majority, from the nature of the obstruction, it must be useless. A single tapping is rarely curative in hydro-nephrosis ; frequently the operation has had to be repeated many times. But if, after three or four tappings have been tried, a cure is not effected, most surgeons would proceed to incision and drainage. Repeated tapping is liable to beget suppuration.

Puncture and tapping of the kidney is best performed with the aspirator. The needle should be of large size, to lessen the chance of its becoming blocked with *débris*. The skin and the needle must be thoroughly aseptic ; and the needle ought to be introduced full of an aseptic fluid, to prevent the introduction of air into the cyst. An air-bubble will rise into a sac of fluid out of the point of an aspirator needle, and filthy epidermic scales may be carried in on the cutting point. An abundant experience

of this very simple operation proves that it is too frequently allied to the experiment of introducing a germ-laden needle into the midst of a cultivation jelly.

The point at which puncture is to be made will vary according to the size of the tumour, its nature, and the side on which it lies. In every case the operation ought to be extra-peritoneal; the needle, therefore, must not be inserted too far forwards. Morris advises that " if there be any spot over the swelling which is thin, soft, prominent, or fluctuating, the trocar should be there inserted. A point which is not seldom indicated is midway between the umbilicus and the anterior superior spine of the ilium; or half an inch below, and an inch and a half to the side of the navel." One danger in puncturing too near to the middle line is, that the colon may be wounded.

Where the tumour is not large, or where no favourable spot presents itself, the site to be selected should be regulated by the anatomy. As a result of several experiments, Morris found that, to puncture the left kidney, the best point of entrance was one " just anterior to the last intercostal space." On the right side, puncture in this situation would probably traverse the liver; therefore, a lower point is selected half-way between the last rib and the crest of the ilium, from two to two and a half inches behind the anterior superior spine of the ilium. " This spot is on a level with the front of the bodies of the lumbar vertebræ, and a needle here passed horizontally inwards will be altogether in front of the normal kidney, and will either transfix or pass in front of the ascending colon when in its usual place. It may, however, with safety be conjectured that, in any case of hydro-nephrosis of the right side requiring to be tapped, if the trocar be inserted at the place I propose, and directed somewhat forwards, the peritoneum and colon will be sufficiently in front to escape injury; the liver will be safely out of reach above, and the kidney behind; while the dilated pelvis of the kidney will be tapped at its anterior and lower aspect." (Morris.)

As soon as the needle is embedded in the skin, the exhausting bottle should be connected; and the needle is then cautiously pushed onwards till fluid is sucked out, when it should be

pushed in no further. Thus the risk of wounding renal vessels is diminished. More than one case has died from extravasation of the cyst-contents into the peritoneal cavity. Wound of the margin of the liver may prove harmless. The risk of wounding the pleura has already been referred to.

Nephrotomy.

CONDITIONS FOR WHICH NEPHROTOMY MAY BE PERFORMED.

Pyo-nephrosis is simply hydro-nephrosis with suppurative inflammation of the lining membrane of the cyst. Between a simple catarrh with shedding of proliferative endothelial cells, and the formation of granulations with abundant discharge of pus, all degrees of inflammation are found. Mucus, blood, and urine are frequently found in the purulent fluid; occasionally it is very putrid. In certain cases, phosphates are found in sufficient amount to form with the pus a sort of paste.

Pyo-nephrosis may be the first effect of a calculus; or it may be an after-development of hydro-nephrosis, either spontaneously evolved, or as a result of surgical interference by tapping. It may originate in any of the conditions already mentioned as productive of hydro-nephrosis, and more particularly from renal calculus. Suppurative calculous pyelitis has already been described under nephro-lithotomy, and need not be further dwelt upon.

The symptoms are those of hydro-nephrosis *plus* suppuration. Elevation of temperature, with or without rigors; hectic; loss of appetite, with perhaps symptoms of uræmia or septicæmia, may be looked for. A tumour may be visible and palpable; but

it rarely attains to the enormous dimensions sometimes observed in hydro-nephrosis. Dulness, if the tumour is large, may be interrupted towards the middle line by the colon passing over it. Fluctuation may or may not be detected. A lobulated outline on palpation may be frequently made out. Pain, cutaneous œdema or redness, and other local signs of suppuration, may be expected. An examination of the urine may reveal the presence of pus, and an estimation of its quantity may show a diminution in amount. Intermittence of the tumour has been found. Occasionally cystitis is set up, from contamination with purulent or putrid urine.

Suppurative Diseases of the Kidney.—There are various distinct forms of suppurative inflammation of the kidney. They may be described as : (1) simple circumscribed renal abscess ; (2) general suppurative nephritis, pyelitis, and pyelo-nephritis ; (3) scrofulous kidney. Such a classification is neither clinically nor pathologically perfect ; it is, however, that usually followed, and may be conveniently adopted here.

(1) *Renal Abscess* has its typical origin in injury, as from a blow, or a calculus, or other foreign body : it may be secondary to peri-nephric suppuration ; and it has been known to follow the administration of cantharides and turpentine. A single abscess may be formed by the fusion of many small ones ; and there may be more than one abscess in the kidney.

Renal abscess is usually limited to one kidney. It may find its way into the pelvis, and thence empty itself into the bladder through the urethra ; or it may burst through the capsule into the surrounding cellular tissue, causing peri-nephric abscess ; or both events may occur. It is by no means rare to find more than one abscess in the renal tissue. In many cases the whole organ is transformed into an abscess, limited by pelvis and capsule, and partly sub-divided by septa.

In acute cases, the symptoms are frequently ushered in with rigors, frequently repeated, and great elevation of temperature. In chronic cases there may be little or no fever at any stage of the disease. Pain in the region of the kidney is usually com-

plained of. Pus may be found in the urine ; if it is considerable in amount, and accompanied with decrease in the size of a lumbar tumour, the existence of renal abscess is almost certain. A sense of increased resistance in the loin to the examining fingers, œdema and redness of skin, and complaints of local pain on pressure, suggest renal abscess. The disease is always attended by great prostration, rapid emaciation, and complete loss of appetite.

(2) *Suppurative Nephritis* is usually described as secondary to some disease of the lower urinary tract. It may be confined to the pelvis, when it is known as pyelitis ; or to the kidney, when it is described as nephritis ; or it may involve the whole renal organ, when it is known as pyelo-nephritis. In its typical development it is best known as "surgical kidney;" that is to say, it has its origin in any disease of the penis or bladder for which surgical treatment has been or may be instituted. As a matter of fact, the disease is more frequently caused by want of surgical treatment than by excessive or erroneous application of it.

From the nature of the disease, both kidneys are usually affected ; and this fact is, in itself, sufficient to forbid a local operation of any magnitude. Suppurative nephritis is, in the great majority of cases, a rapidly fatal complaint ; and surgical treatment offers little or no hope of cure.

(3) *Scrofulous Kidney*—or scrofulous pyelo-nephritis, as it is sometimes called—is an inflammation of the kidney, attended with the formation of the characteristic cheesy material. It is a constitutional disease. Of 95 cases reported by Dickinson in which death took place from scrofulous kidney, only 11 were free from similar disease in the other kidney or elsewhere. As these were all cases of death from scrofulous kidney, it is probable that the proportion of intercurrent disease would be higher than when the patient first came under observation. Still, in the view of operative proceeding, the undoubted frequency of outlying scrofulous mischief in cases of scrofulous kidney ought to teach caution.

The appearance of a typically scrofulous kidney is charac-

teristic and unmistakable. The organ is enlarged as a whole—
sometimes to three, four, or even six times the normal dimen-
sions. On section, aggregations of the well known cheesy
products are seen replacing, and more or less accurately
following, the outlines of the individual lobules. These cheesy
masses are partially divided from each other by incomplete
septa, representing the divisions between the lobules, and
containing remnants of the original secreting tissue. On
these septa, and on the inner surfaces of the capsule and the
pelvis, ragged œdematous granulations are exposed when the
purulent material is removed. Sometimes the abscesses are
large, while the septa between them are thin and short ; in such
cases pyelitis will be superadded to nephritis. In other cases,
the abscesses are small and the septa are very thick. The
inflammation spreads from the pelvis down the ureter, which
also becomes thickened in its walls and ulcerated on its surface.
This thickening and ulceration of the ureter frequently descends
as far as the bladder, and is one of the characteristic con-
comitants of such scrofulous kidneys as may be brought under
operative treatment.

The symptoms of scrofulous disease of the kidney are often
obscure or misleading. Occasionally there are no local signs,
only vague general signs of ill health, with perhaps slight indi-
cations of urinary disorder. Usually there is continuous pain
in the loins of a dull aching or dragging character. But this
pain is often aggravated, occurring in paroxysms, as in renal
colic, and due, in all probability, to blocking of the ureter by
débris. Pus in the urine is a very constant sign of scrofulous
kidney ; its presence in the bladder may set up irritation, or
even strangury, and lead to a suspicion of calculus. Blood also
is often mixed with the pus in the urine, and more particularly
during the early stages of the disease. Granular detritus, and
pieces of cheesy matter, soluble on the addition of acetic acid,
are often detected on microscopical examination. I have been
concerned in the treatment of two cases of scrofulous kidney in
which tubercle-bacilli were found in the urine ; and others have
had a similar experience. Locally a hard tender swelling in the

region of the kidney may usually be felt. Elevations of temperature occurring at irregular intervals, lasting for short periods, and accompanied often with rigors and sweating, are said to be characteristic. The patient rapidly loses strength and flesh ; the skin becomes dry and hard ; diarrhœa and sickness set in ; and death takes place from exhaustion.

Scrofulous kidney is liable to be confounded with cancer of the kidney, pyo-nephrosis, calculous pyelitis, and even with certain diseases of the bladder or prostate. The presence of blood in the urine, and the hardness of the growth in scrofulous kidney, are the conditions which may give rise to a diagnosis of cancer. Abundance of pus in the urine, with granular detritus and perhaps bacilli, and elevation of temperature, are mainly to be relied on as diagnostic. From other forms of suppurative inflammation, the history and the hectic character of the temperature will be the most important elements in differentiation.

Peri-nephric Abscess is in most cases a sequence of suppuration in the kidney itself. It occurs also as a primary idiopathic disease, quite independently of the kidney, and also as a consequence of urinary extravasation or renal fistula. As a primary disease, it is usually an effect of injury of some sort. Occasionally it occurs as a sort of metastasis, from operation upon, or inflammation in, distant parts of the urinary or generative organs ; and not infrequently there is a visible and continuous connection between suppurative inflammations in distant parts as in the appendix vermiformis and the peri-nephric abscess. The historic nephro-lithotomy was essentially the evacuation of a peri-nephric abscess, which contained a calculus that had ulcerated its way through the renal tissues.

Rarely does a peri-nephric abscess burst through the peritoneum. Rather does it burrow in various directions along the fasciæ surrounding the contiguous muscles, ultimately reaching the surface somewhere in the loin : not infrequently the matter gets into the sheath of the psoas, and reaches the inguinal region, after the manner of a psoas abscess. With curious frequency the matter finds its way through the diaphragm into the lungs,

and is expectorated. I have removed a vesical calculus weighing more than nine ounces from a man who had a sinus between the seventh and eighth ribs, which led downwards to a peri-nephric abscess, and upwards into a pulmonary fistula, through which pus was discharged in large quantities by the mouth. Peri-nephric abscess has been known to burst into the colon, the duodenum, and even into the bladder.

The symptoms of peri-nephric abscess are, in the first place, those of deep-seated suppurative inflammation, with its ordinary local and general concomitants, situated in the tissues surrounding the kidney. Further special signs have been observed : such are, lameness on the affected side, with flexion of and inability to extend the thigh, due to involvement of the psoas, and œdema of the foot and ankle. Dr. John Roberts of Philadelphia,* after an elaborate study of the condition, gives directions for the localising of peri-nephric abscess as follows : in all anterior regions, we may expect pain, tenderness, swelling, œdema, or pointing in front or at the side of the abdomen. In all posterior regions, we look for pain, tenderness, swelling, œdema or pointing in the loin. In the upper tracts, peri-nephric abscess will probably cause pleuritic friction, pleural effusion, empyema, expectoration of pus, and dypsnœa ; on the right side we may expect to find œdema of both legs, jaundice, fatty stools, persist-ent vomiting, rapid emaciation, and ascites. In the middle tracts, there may be albuminuria and casts ; supra-pubic, scrotal, or vulvar pain, or anæsthesia ; suppression of urine ; uræmia ; pyuria ; œdema of the scrotum. In the lower tracts, he tells us to expect with peri-nephric abscess, flexion of the hip ; pain or anæsthesia in the front, the outside, or the inside of the thigh ; pain in the knee ; scrotal or vulvar pain, or anæsthesia, without albuminuria ; unilateral œdema of the leg ; abscess pointing near Poupart's ligament ; with constipation on the left side, and involvement of the receptacle for chyle on the right side.

Calculous Suppression of Urine may be taken as a condition for which nephrotomy may be performed. In 1880 Weir advocated

* *Trans. Amer. Surg. Ass.*, ii., 1885, p. 518.

nephrotomy for calculous suppression. Bennett May* forcibly argues in favour of the operation. Bardenheuer, according to Weir, has removed a calculus the size of a bean from the ureter, and four others from the pelvis of the kidney. Morris in a very suggestive paper † on the feasibility of removing a calculus impacted in the ureter, speaks in favour of the proceeding. No patient should be permitted to die of calculous suppression without a serious attempt to discover the site of the obstructing calculus. If low down in the ureter, the calculus may possibly be removed after the manner suggested by Morris. If high up, it may be removed by nephro-lithotomy, or perhaps by pyelo-nephrotomy. If its site cannot be discovered, then pyelotomy and the establishment of urinary fistula will at least save the patient's life. A remarkable example of the value of nephrotomy for total suppression of urine is afforded by a patient of Clement Lucas's, from whom one kidney had been excised four months previously, and from whose remaining kidney a large calculus was removed. The question of ureterotomy for such conditions is discussed further on.

Indications to Operate.—Nephrotomy is indicated in all cases of cystic enlargement where puncture has failed. More precisely it is called for in cases of simple cyst where tapping has been performed five or six times without effecting a cure. Nephro-tomy as an original operation has, according to Newman, been performed 21 times without a death for cases of hydronephrosis and cystic disease. In seven of these cases a fistula remained in the loin. In hydatid disease, if one tapping does not kill the parasite or check the growth of the tumour, nephrotomy may properly be performed. In hydro-nephrosis, if the cyst rapidly refills after two or three tappings, or if rupture seems imminent, nephrotomy is indicated. In every case suppuration in a cyst is an indication for incision and drainage.

In all cases of suppuration in and around the kidney, incision, with evacuation of pus and drainage of the abscess-sac, is indi-cated. Contra-indications in such cases are—firstly, such a

* *Brit. Med. Journ.*, Mar. 8th, 1884.   † *Amer. Journ. Med. Sc.*, Oct., 1884.

condition of exhaustion as would negative any serious surgical exploit ; and, secondly, a diseased condition of the opposite kidney. Wherever operation for abscess is feasible, nephrotomy ought to be the first operation. The prime object is, evacuation of pus ; secondary objects are, diagnosis of the actual state of affairs and determination of the chances which nephrotomy provides towards cure, and preparation of the kidney and the patient for the major operation of nephrectomy where mere incision cannot be expected to be curative. Nephrectomy performed in the first place as an operation for suppurative lesions of the kidney, is not so successful as nephrectomy performed as an operation following on nephrotomy and drainage. The patient gains strength after evacuation of an abscess, and the kidney decreases in size ; while the vascularity of the organ and the density of its adhesions become less marked after drainage.

Rarely is operation admissible in suppurative nephritis or pyelo-nephritis—in uro-septic or surgical kidney. Scrofulous kidney as often calls for excision as for incision—at least, when the abscesses are small and numerous.

Before performing nephrotomy it is advisable, though not necessary, to take measures for ascertaining the condition of the other kidney. But the justifiability of the operation will be the urgency of the disease. Whether the opposite kidney is sound or not, renal or peri-renal abscess which is endangering the patient's life must be evacuated if the general condition will warrant operation.

THE OPERATION OF NEPHROTOMY.

The incision is the same as that already described as suitable for nephro-lithotomy, and the structures divided are identical. This holds good for suppurative lesions, if there is no great ncrease in size, and no visible tendency to point through the skin. If the renal enlargement is considerable, the incision may be carried farther forward ; and redness, swelling, or other indications of pointing, must be taken as marking the best site

for making an opening. In cases of non-suppurative cystic enlargements, the ordinary lumbar incision will usually be best. True, it may be more easy to make the opening farther towards the front in cases of considerable enlargement, and in doing so there would be little risk of entering the peritoneum. But, looking to the results sought to be attained—drainage of the cavity, and shrivelling of the cyst—the advantages of having the kidney or its remnants fixed well behind around the opening made, and of having a dependent opening for drainage, weigh in favour of the ordinary lumbar incision.

If the operation is for hydatids, simple cyst, or hydro-nephrosis, there may be no peculiarity in the tissues traversed. The circumrenal fat will be thinner than normal, being either spread out over the swelling or atrophied from pressure. Adhesions to surrounding tissues may be present in hydatids. A portion of the cyst-wall is denuded of overlying fatty tissue to an extent sufficient to permit of its being brought to the surface, and sutured there after being opened. An excellent mode of making the opening is to push a Lister's sinus forceps either directly through the cyst-wall or through a small opening made by a tenotome, and dilate the opening by separating the blades. As the contents flow outwards, the cyst-wall is pulled to the surface by means of forceps attached to the margin of the opening. Frequently it will be found impossible to pull the cyst-wall quite to the level of the skin; then fixation of the opening in the cyst to tissues as near to the surface as possible may be tried, or the opening may be left to itself when a drainage tube has been inserted. In every case evacuation of the contents is to be assisted by pressure from the abdominal aspect.

In operating for suppurative lesions, we may find the skin, muscles, and fasciæ traversed by the incision to be abnormally vascular and œdematous. The circumrenal fat may be hard, dense, and firmly adherent: often it contains numerous small abscesses. A small area of the renal capsule is exposed, and through this the largest needle of an aspirating syringe is pushed. If matter is struck, it is, as far as possible, evacuated at once;

if not, the needle is carefully pushed in the most likely directions till purulent fluid is met with. Along the side of the aspirating needle a knife or dilating forceps is pushed, to enlarge the opening sufficiently to admit the finger. Curdy matter which will not run through a tube is scooped out with the finger, and the cavity thoroughly explored. If openings into other abscess cavities are found, these are dilated, if necessary, and their contents removed: if this is impracticable, direct openings are made through the convex surface. In each cavity, and reaching to the bottom of it, a drainage tube is placed. Finally, through the tubes the abscess cavities are thoroughly washed out by irrigation with an antiseptic lotion. The matter found in renal abscesses is often very offensive, and frequent irrigation with antiseptic lotions may be necessary.

In exploring a scrofulous kidney, the septa between the abscesses should not be torn or cut through, as they are often very vascular. The finger should be pushed into the pelvis if possible, to ascertain whether the upper end of the ureter is pervious.

In peri-nephric suppuration, after evacuating the pus, the renal surface ought to be carefully examined, to ascertain whether nephric abscess co-exists. Such an abscess must, of course, be opened and drained.

The wound, after careful disinfection and cleansing, is closed around the drainage tube or tubes in the ordinary manner. Thick rubber, perforated only where it traverses renal tissue, makes the best drainage tube. It may be fixed by a stitch to the skin. Absorbent dressings are fixed over the wound by means of an abdominal binder.

The progress of the case will depend on the nature of the operation. In hydatid disease the cavity will probably spontaneously close after suppuration. In simple cyst primary closure may be expected, without discharge of pus. In hydronephrosis, a fistula will in most cases be left, for which there is no cure without further operation. The patient's life may be made fairly comfortable by the use of such a receptacle as that invented by Morris. An attempt may be made to close the

fistula by a plastic operation, but it is not often successful. Nephrectomy may then be contemplated.

Nephrotomy for abscess is frequently a curative proceeding —more frequently, probably, than published records would lead us to suppose. Even if cure do not follow, no harm is done, but rather good. For the patient, in view of further operative proceedings by nephrectomy, has been tided over the immediate danger of an acute illness, and has gained strength ; while the kidney is diminished in size, its vessels are smaller, its tissue is less friable, and its surroundings are more tolerant of surgical interference.

Nephrectomy.

Nephrectomy is the name given to removal of the kidney by surgical operation.

History.—According to Heineke,[*] Zambeccarius was the first to contemplate the operation of nephrectomy, and sought to prove its feasibility by operations on dogs. S. Blancard successfully extirpated the kidney in dogs; and several surgeons who saw the operation considered that it might be performed on human beings. Rayer condemned the operation where the kidney was inflamed (as in calculous nephritis), because then it would be so closely adherent to the peritoneum that it could not be disturbed without injuring that membrane. Blundell experimentally performed nephrectomy on animals.

Nephrectomy had been performed unintentionally several times before it was carried out deliberately as a planned opera-

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[*] Von Pitha and Billroth's *Surgery.*

tion. In 1860, Walcott of Milwaukee* removed a cancerous kidney, believing it to be a hepatic cyst. Peaslee and one or two others have removed renal cysts, believing them to be ovarian tumours. Walcott's case lived fifteen days; the others succumbed more quickly. The first planned operation was performed by Simon of Heidelberg, in April, 1869. Before operating on the human subject, he had experimented on animals. His operation was performed for incurable fistula of the ureter, and his patient—a lady—made an excellent recovery. Since 1869, the operation has been performed at least 350 times, and with a steadily decreasing mortality.

Conditions for which the Operation may be Performed.—These may be classified as follows :

(1) The same class of diseases as call for nephrotomy when this operation is not likely to succeed, or has already been tried and failed.

(2) New growths of the kidney.

(3) Ureteral and renal fistulæ.

(4) Serious injury to the kidney, with hæmorrhage, urinary infiltration, or destructive suppuration.

(5) Disease or degeneration in movable kidney.

(1) In the category of *failures after nephrotomy* we may include all cases where a renal fistula is left. This may happen after incision for any cystic or purulent collection, in simple hydatid cysts, in hydro-nephrosis or pyo-nephrosis, and in renal suppurations of all sorts. The original disease may be cured; the fistula is an accidental complication, which has to be raised to the dignity of a separate disease, and counted as a special indication for operation.

By far the most important class of failures after nephrotomy which may demand nephrectomy is supplied by suppurative lesions of the kidney. On account of multiplicity of abscesses, it may be impossible to open and drain them all; a large abscess

* *Phila. Med. and Surg. Rep.*, 1861, p. 126.

may have been opened, and several small ones may have been
overlooked ; the abscess-sacs may be very slow to collapse, and
the patient's strength may be ebbing away from prolonged sup-
puration ; these and similar considerations may suggest the
major operation.   Again, in some cases nephrotomy is deliber-
ately performed as a temporary measure, intended to effect
improvement in the local as well as in the general condition,
before nephrectomy is undertaken.   Bruce Clarke, Lucas, and
others have specially insisted on the value of this measure.

Among diseases ordinarily amenable to nephrotomy, a certain
number will be met with where this operation would evidently
prove futile, and where nephrectomy gives the only chance of
recovery.   Scrofulous kidney would perhaps furnish the greatest
number of examples under this head.   The organ may be
riddled with abscesses, which can neither be evacuated nor
drained without causing great hæmorrhage or seriously damaging
the renal structure.   In this case a complete nephrotomy would
result in chopping the kidney into fragments, and would be a
more grave affair than nephrectomy.   Any variety of extensive
suppuration that is not localised in one district demands nephrec-
tomy.   Calculous nephritis may be of this nature.   Very exten-
sive suppuration has followed injury to the kidney : Von Bruns,
under these circumstances, had on one occasion to remove the
organ.

(2) *New growths* of the kidney may be another indication
for nephrectomy.

The subjoined table of renal tumours by Mr. Reginald
Harrison,* presents a useful and clear classification from the
clinical aspect.   It includes conditions which are not neoplastic,
but which at the bedside are practically tumours :—

I. *Of Congenital Origin.*	⎧ Sarcoma ⎫
	⎨ Cystic Disease
	⎪ Hydronephrosis
	⎩ Cavernous tumours

* *Twentieth Century Practice of Medicine*, vol. i., p. 165.

II. *Of Post-congenital Origin.*

Extra-renal
- Abscess
- Cysts
- Myxo-lipoma
- Tumours of the Adrenal

Pelvic
- Hydro- and pyo-nephrosis
- Villous tumour
- Carcinoma

Glandular and Capsular
- Hydatid Cysts
- Cystic disease
- Tubercular disease
- Lymphadenoma
- Syphilitic deposits
- Lipoma
- Fibroma
- Sarcoma
- Adenoma
- Carcinoma
- Secondary growths

Many other classifications have been offered, notably the exhaustive ones of Newman and of Paul; but the above, prepared after special opportunities for study, may be accepted as trustworthy.

Cystic tumours of the kidney have already been dealt with, under puncture and nephrotomy. There remain for consideration the solid growths; and these, as will be seen from the classification, are mostly of a malignant nature. Sarcoma, both of congenital and of adult origin, is by far the most important; and carcinoma comes next in importance and in frequency. In a most valuable study of Primary Malignant Disease of the Kidneys, Minges[*] found that of 63 cases, 30 were sarcomata, 30 carcinomata (21 encephaloid — probably most of them really sarcomata), 1 adenoma, and 1 fibro-cystic. It is clear, however, that different men reporting their cases have followed different classifications, and no exact conclusions

[*] *Journ. Amer. Med. Assn.,* June 6th, 1885, *et seq.*

can be drawn from the nomenclature adopted.   Billroth removed a papillomatous growth.   Adenoma is, in one case, given as the name of the tumour for which the kidney was removed. Further consideration of minor varieties of new growths may be dismissed ; our purpose here will be fulfilled by an account of primary malignant disease, as represented by sarcoma and carcinoma.   Secondary malignant disease does not concern the operating surgeon.

Malignant growths of the kidney show a curious predilection for youth and for old age; they are least common during adult life.   Of all cases of renal tumour nearly 40 per cent. are in children.   Congenitally, sarcoma is the form of malignant disease usually met with : carcinoma, though not unknown, is, as Ebstein states, very rare in infancy and childhood ; it is more common in old age.   Traumatic irritation, as by calculus, is now admitted to be a contributive cause of renal cancer.   The disease occurs with equal frequency in both kidneys; very rarely does it exist in both organs at the same time.

The tumour frequently attains to enormous dimensions ; and this is particularly true of growths occurring in children.   Roberts records an example found in a child of six, where the tumour weighed 31 lbs.   In its growth the tumour extends into the pelvis, often blocking the ureter, and sometimes passing down it for a considerable distance.   The renal vein soon becomes involved ; and through it the cancer may grow inwards to the vena cava, thus providing a focus from which infarcts may be carried into lungs or liver.   The retro-peritoneal glands escape with curious frequency.   Ebstein says that secondary deposits are found in more than half the cases that die of the disease. Local extension into peri-renal tissue is not very common ; and invasion of neighbouring structures—vertebræ, ribs, intestines, stomach—though described, is even more rare.   I have seen a case of primary cancer of the kidney, where the omentum alone was attacked by local extension of the disease.   Though malignant disease of the lower urinary tract, in testis, prostate, or bladder, frequently infects the kidney, the reverse is practically unknown.

Symptoms.—Roberts says: "The distinctive symptoms of cancer of the kidney are, tumour in the abdomen and hæmaturia. In every case in which it was the determining cause of death, either one or both were present." If this is not accurately true, it is certainly very approximately so. Minges found a tumour absent only three times in 103 cases, and in two of these cases a tumour was not discovered because it was not carefully looked for. A tumour is always present in children, and frequently it is of enormous size. Hæmaturia is found in about half the cases, and in a far greater proportion of those which claim origin from injury. It is usually irregularly intermittent, and occurs in varying amount at all stages of the disease. Occasionally the blood is very abundant, forming clots in the ureter or bladder, and causing renal colic or vesical tenesmus. The urine in the intervals of bleeding is usually normal, though pus-cells and tube-casts are sometimes found.

Pain, as a symptom of malignant disease of the kidneys, is found in most, though not in all, cases. It is situated chiefly in the loin and abdomen, but radiates widely in all directions around the back and shoulders, and down the front and back of the thigh.

The physical signs are, shortly: a solid tumour situated in the loin, growing forwards, and not at all bulging backwards; rounded and smooth where palpable; resisting movements on pressure, and not descending on inspiration; dull on percussion from the spine forwards, except perhaps along a vertical line in front where it is crossed by large intestine. It is characteristic of renal tumours, that when the lumbar hollow is filled up, all further development is forwards. Renal tumours may be diagnosed from hepatic and splenic enlargements by the fact that they are rounded on all sides where exposed to the examining fingers. There is no notch or sharp edge anywhere. Fixation is said to be a characteristic of renal growths: they impart to the feel a peculiar sense of resistance when attempts are made to move them in any direction. There are, however, exceptions to this rule. There is no resonance in the flank. The large intestine crossing in front of the tumour is, when present, a valuable

diagnostic sign. The ascending colon usually passes over the front and inner side of the growth; the descending colon passes in front, and a little to the outer side. If distended, the colon may be detected by its resonant note on percussion; if empty, it may be felt and rolled about by the fingers.

Renal growths are liable to be confounded with hepatic enlargements on the right side, splenic enlargements on the left, and also with fæcal accumulations and tumours of the ovary. Hepatic tumours have no bowel in front, and the liver margin can often be felt. A space into which the fingers may be pushed is usually left between the upper extremity of a renal growth and the edge of the ribs. An enlarged spleen has no bowel in front; it has a well-defined edge, in some cases notched. Fæcal accumulation only requires to be mentioned as a possible source of error. Cystic enlargements of the kidney are more likely to be mistaken for ovarian tumours than solid growths.

(3) *Urinary fistula* connected with ureter or kidney may be an indication for nephrectomy. Simon's operation was, as already remarked, performed for ureteral fistula. In most cases ureteral fistula is a result of an operation wound. It may be produced by sloughing after a difficult labour. The operation of nephrectomy has been performed at least eight times for urinary fistula. Ureteral fistula may be cured by a plastic operation: this will be discussed under the Surgery of the Ureters.

Renal fistula may be produced by wounds of, or by disease in, the kidney. In the great majority of cases, it opens in the loin. But rare examples are found of renal fistula opening into various parts of the intestines, into the stomach, and into the lung. Renal fistula opening into the peritoneum is rapidly fatal, if not treated.

The diagnosis of these conditions requires no description.

(4) Cases of grave *injury to the kidney*, involving rupture of the organ with free bleeding, may call for nephrectomy as the only chance of saving life. The danger is not so much from the amount of bleeding, as from the clotting of the blood in the

bladder, with resulting inability to pass urine. Rawdon* of Liverpool performed nephrectomy in a case of this sort, and would have saved his patient's life, had it not been that decomposition of blood in the bladder set up cystitis and suppurative nephritis of the opposite kidney, and this in spite of cystotomy performed four days after the nephrectomy.

In cases of urinary infiltration, with destructive suppuration, nephrectomy may be called for. But the major operation will, in most cases, be adopted only as a sequence to lumbar incision and drainage. West, Bennett May, Barker, Weir, and others have published cases of this sort.

(5) An account has already been given of the diseases or degenerations which are liable to attack movable kidney. Here the indication to operate will usually be enlargement accompanying the mobility ; and in most cases the decision to proceed to removal will only be come to after exposure and examination of the organ.

Mortality and Appreciation of Nephrectomy.—The statistics of nephrectomy have been collected by Harris, Billroth, Gross, Weir, Baum, Minges, and others. The general mortality was given by Harris,† in 1882, as 45 per cent.; by Billroth,‡ in 1884, as 47 per cent.; by Weir,§ in 152 cases, as 50 per cent.; and by Gross,‖ in 1885, in 233 cases, as 44.6 per cent. The latest statistics :—of Baum,¶ adding 72 cases up to February, 1884, giving a mortality of over 50 per cent.; and of Minges,** giving 60 cases of operation for primary malignant disease, with 46 deaths,—show little improvement. Amongst the most complete statistics are those of Newman.†† Nephrectomy has been performed for hydronephrosis and cystic disease 46 times,

* *Lancet,* May 26, 1883.
† *Amer. Journ. Med. Sc.,* July, 1882. ‡ *Wien. med. Woch.,* 1884, Nos. 23, 24, 25.
§ *New York Med. Journ.,* Dec. 27th, 1884.
‖ *Amer. Journ. Med. Sc.,* July, 1885. ¶ *Phila. Med. Times,* Feb. 21st, 1885.
** *Journ. Amer. Med. Ass.,* June 6th and 13th, 1885.
†† *Surg. Diseases of Kidney.* 1888.

with 18 deaths; for suppurative disease without calculus 54 times, with 18 deaths; for suppurative disease with calculus 61 times, with 22 deaths; for tubercular disease 33 times, with 12 deaths; and for tumours of various sorts 74 times, with 24 deaths. This gives a total of 268 operations, with 94 deaths. In Newman's list are also included 30 nephrectomies for movable kidney, with 9 deaths, and 27 for traumatic lesions, with 8 deaths. The total mortality is 35.2 per cent. The results of individual operators of experience are more favourable, but not strikingly so. Under the most advantageous circumstances, a general primary mortality may be expected, in all cases of nephrectomy, of something under 40 per cent.

In malignant disease recurrence takes place in a proportion of 40 per cent., according to Martin of Berlin. Gross estimates that recurrence takes place in a third of all the cases, and that the average duration of life is two years: of 13 operations on children, only 4 recovered; and all of these died later. Some three or four cases of permanent recovery in children, after nephrectomy for sarcoma, have since been recorded; so that the prospect may not be as hopeless as Gross left it.

Dr. Emily Lewi* has collected and tabulated 60 cases of nephrectomy for renal sarcoma in children. The operation mortality was 28½ per cent. But recurrence took place in nearly all the cases: at the time of writing only three cases had passed the three year limit. She says: " A critical reading of the table demonstrates that the chances of attaining old age or even adult life are almost *nil*."

The results vary according to the nature of the disease for which operation is performed. The worst results are got for malignant disease—nearly 70 per cent. die. For strumous kidney, the mortality is about 36 per cent. Here it was found that previous nephrotomy did not prove advantageous. For suppurative lesions, Gross found that nephrectomy, without antecedent nephrotomy, gave a death-rate of nearly 50 per cent.; while nephrotomy gave a death-rate under 30 per cent. Bolz and Weir give not very different results.

* *Arch. of Pediatrics.* N.Y., Feb., 1896.

Indications and Contra-indications.—With results such as those described, it is not surprising that nephrectomy should be looked upon with some degree of disfavour. No doubt the mortality has been increased by a selection of unfavourable cases, or by delaying the operation too long. Under the most favourable circumstances, however, it may be taken for granted that the mortality of nephrectomy will always be high. In favour of the operation, even thus loaded with a terrible death-rate, it may be urged that it is performed for a certainly fatal disease ; a complete success is a life saved; a failure is simply an accelerated dying.

For sarcoma and cancer, the position of the operation would probably be as follows : In all cases where the disease has been known to exist for some months, where the growth is large, and particularly if it is firmly adherent in the loin, no operation is advisable. In children, unless the growth is small, the patient healthy and not less than four or five years of age, operation is of doubtful value. In a word, for malignant disease, nephrectomy is a justifiable procedure only in a very few specially selected cases. It is right to add that, for children, Gross forbids operation altogether.

In hydro-nephrosis, as in cystic disease, removal ought not to be undertaken till incision has been tried and has failed. Billroth considers that for hydro-nephrosis, nephrectomy ought never to be performed. In a third of the cases, removal has been carried out after mistaking the disease for ovarian cystoma : naturally, the mortality is much greater than after incision. If fistula remains, this may be palliated or treated later on with more chance of success by nephrectomy.

In suppurative lesions, the question of excision as against incision will depend—firstly, on the condition of the patient ; and, secondly, on the state of the organ. It may be laid down as a rule never to be departed from, that no suppurating kidney should be removed without first making a careful examination through an exploratory incision into its substance. Also, the major operation should not be performed if the patient is very weak. The mortality of nephrotomy is less than that of

nephrectomy, but not so much less as might be expected : the per-centage of recoveries in favour of the former operation is only twenty-five. Still, this is decisive where nephrotomy is likely to be curative. But certain cases will evidently not be cured by nephrotomy : in these, it may even be doubtful whether traumatic interference will not be positively harmful ; and it may appear that the patient, on the operating table, is in a condition as favourable as he is ever likely to be for operation. Such cases will usually be scrofulous ; and, as a matter of fact, the mortality after nephrotomy for scrofulous kidney is just as great as after nephrectomy. In every case where ne-phrotomy presents a fair chance of cure or even of amelioration, it should be selected ; where nephrotomy is out of court, and the patient is likely to bear it, nephrectomy may be performed.

For wounds in the kidney and their consequences, nephrec-tomy has been performed by Brandt, Marvand, Cartwright, Rawdon, and Bruns—five times, with two deaths. If death seems to be imminent from hæmorrhage, and after exploratory incision it is found to be impossible to check the bleeding, then nephrectomy ought to be performed. Keetley* has, for a case in which the lower end of a kidney was crushed off by a wagon-wheel, successfully operated by removing the crushed and separated portions, checking the bleeding by compression. Another successful case of partial nephrectomy for injury is reported by Herczel as occurring in Czerny's clinic. † Clots in the ureter may cause suppression of urine ; in the bladder, they may prevent the discharge of urine, or set up cystitis : here also, if bleeding cannot be checked, and life is being endangered, nephrectomy is indicated. Where suppuration, with extravasation of urine, follows rupture of the kidney, incision or removal is indicated, according to the gravity of the condition and the state of the patient.

Urinary fistula, renal or ureteral, if it causes great discomfort and prevents the patient from following a necessary occupation, may be an indication for nephrectomy. Simon, Archer, Boeckel

* *Brit. Med. Journ.*, July 19th, 1890.
† Abstr. in *Annals of Surgery*, Nov., 1890.

and others, have operated for ureteral fistula caused by accidental wound inflicted during hysterectomy. The greatest number of operations have been performed for renal fistula left after nephrotomy, and here the results have been most favourable.

Methods of Ascertaining the Condition of the other Kidney.—Before proceeding to remove one kidney, it is well to ascertain as accurately as possible whether the other kidney is sound; or, in fact, whether it exists. Though it has been estimated that the kidney is solitary only once in 4,000 cases, it has been the unfortunate lot of one surgeon to remove such an organ. This was the remarkable case of Polk,* in which a displaced kidney, lying on the left side above Poupart's ligament, was removed, and found, at the post-mortem examination eleven days later, to be the only kidney. In cases of suppurative disease where nephrectomy is contemplated, the importance of ascertaining the functional capacity of the organ to be left can scarcely be over-estimated. It is not surprising, therefore, that many devices with this object in view have been introduced; and it is, perhaps, no less surprising, considering the inherent difficulty of the procedure, that, except perhaps in the female, none of these devices is entirely satisfactory.

Tuchmann† invented a compressor, something like a lithotrite, for the ureter, which he improved in 1880. Hegar‡ proposed temporary ligature of one ureter through the vagina.

Simon,§ in 1875, practised direct catheterisation of ureters through the dilated urethra in the female; but after much practice, he attained to only a qualified success. In 1876 Grünfeld ‖ used Simon's method with the help of an endoscope.

Pawlik of Vienna ¶ claims to have been the first to sound the ureters in the female without dilating the urethra. Using as guides certain folds in the vaginal wall, he has succeeded in

* *New York Med. Journ.*, Feb. 17th, 1883.
† *Wien. med. Woch.*, 1874, No. 20.   ‡ *Operat. Gynäk.*, 1874, p. 456.
§ "Uber die Methoden die Weibliche Urinblase," &c.,
Samml. klin. Vortr., No. 38.
‖ *Wien. med. Presse*, 1876, Nos. 27, 28.
¶ See letter in *Glasg. Med. Journ.*, July, 1885.

passing hollow sounds into the ureters of the female 150 times in the dead subject, and 50 times in the living. His method has recently been much improved, but has not come into general use in this country.

Silbermann* sought to compress the ureter by small rubber bags, filled with quicksilver, introduced through a large silver catheter. Newman of Glasgow, in cases of his own, and in one of Dr. McCall Anderson's, has used Silbermann's method with success. But Newman has introduced a plan of his own, in which sight, with the help of an electric lamp in the bladder, is called in to help in the passing of the catheter into the ureter.

Sands recommends the insertion of the hand into the rectum, and compression of the ureters by the fingers.

Glück† recommends a proceeding even more serious; namely, compression of the ureter by forceps through a lumbar incision. The opposite kidney is supposed to be sound if iodide of soda, or ferro-cynanide of potassium, administered to the patient, is found in the urine secreted by the other kidney. But a kidney advanced in disease might elude this test.

Polk ‡ has devised a clamp for compressing the ureter, one blade being inside the bladder and the other in the rectum. The bladder being washed out, the urine secreted by the other kidney can be got in a fairly pure state and examined.

Davy's rectal lever has been used, with somewhat uncertain results, to compress the ureter as it crosses the brim of the pelvis. On the right side it can be employed only when there is a well-developed mesentery to the rectum.

Fenwick's § ingenious apparatus for performing suction of the ureters in the male promises to be valuable; but it has scarcely been more than tried.‖

For catheterisation of the ureters in the female, the method of Howard Kelly of Baltimore is at once the simplest and the most satisfactory. His own latest description is given: ¶ "Its

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* *Berl. klin. Woch.*, No. 34, 1883.   † *Centralbl. f. Chir.*, Dec. 10th, 1881.

‡ *New York Med. Journ.*, Feb. 17th, 1883.   § *Lancet*, Sept. 18th, 1886.

‖ For an exhaustive consideration of the methods of exploring the ureters in the female, see M. D. Schultz, *Nouv. Arch. Od'bstet. et de Gynéc.*, ii., 5, p. 205

¶ *Twentieth Century Practice of Medicine*, vol. 1, 1895, p. 675.

essential features are—1, an atmospheric dilatation of the bladder induced by posture; 2, the introduction of a simple straight speculum without fenestra; 3, the examination of the mucous surfaces of the bladder and urethra by means of a light conveyed

FIG. 196.

Howard Kelly's Speculum, with Obturator for Cystoscopy.

into the bladder. . . . The following instruments are required: a good light and a head-mirror; a urethral dilator; a speculum with an obturator (Fig. 196); a suction apparatus to empty the

bladder completely (Fig. 197); a pair of long mouse-tooth
forceps (Fig. 198); a searcher for discovering the ureteral
orifice (Fig. 199)."

A general anæsthetic is not necessary unless the patient is so
nervous that she will not submit to any kind of an examination.
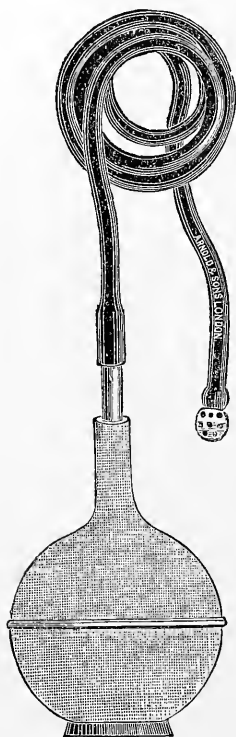
FIG. 197.

*Howard Kelly's Evacuator
for completely emptying the
Bladder of urine after
introducing the Speculum.*

FIG. 198.

*Howard   Kelly's   delicate
Mouse - toothed Forceps for
conveying pledgets of cotton
into the Bladder through the
Speculum.*

For this reason, it is sometimes of advantage to use ether or
chloroform during the first examination, which is apt to be more
prolonged than the subsequent ones. If the urethra requires any
dilatation, a drop of a ten per cent. solution of cocaine painted on

its external orifice, or a piece of cotton wrapped on an applicator saturated with a four per cent. solution and laid just inside the orifice, will be sufficient to blunt the sensitiveness.

Immediately before examination the patient must pass water, preferably in the standing position. In spite of this effort to empty the bladder completely, a little residual urine almost always remains behind. If the examination is delayed ten or fifteen minutes, five or ten cubic centimetres will be added.

The urethral orifice is now dilated by using a conical dilator, blunt at the point, 72 mm. long and 16 mm. in diameter at the base and 4 mm. at the point. This is covered with vaseline, and with a screw-like movement gently bored into the urethral orifice. Two or three gentle movements, holding the dilator poised between thumb and forefinger, will be sufficient to carry it in as far as the number 10 mark on the scale on its side. This indicates a dilatation of 1 cm. in diameter, sufficient for all ordinary purposes of investigation of the bladder, treatment of its surfaces, and catheterisation of the ureters. In many cases, particularly in women who have borne children, the orifice needs no dilatation to permit the introduction of a speculum of this size. The utmost damage done by the dilatation is a slight superficial injury to the mucous surface of the posterior margin of the urethra, which never requires attention. . . . " The speculum (Fig. 196) is a simple metal cylinder 8 cm. (3 in.) long, of equal diameter from end to end, funnel-shaped at its outer end, and with a long handle

FIG. 199.

Howard Kelly's Searcher for testing Ureteral Orifices.

that can be conveniently grasped in the full hand, and which is
provided with an obturator. The diameters of the specula vary
from 5 mm. up to 20 mm. ($\frac{1}{5}$ to $\frac{4}{5}$ in.), shown by Simon to be
the safe outside limit. . . . The sizes
most useful are Nos. 8, 10, and 11. No. 8
can be introduced into almost any urethra
without preliminary dilatation, as it is scarcely
larger than an ordinary catheter. . . .

"The patient may be examined either
in the dorsal or knee-breast position. If
in the dorsal position, she is placed on
the table with legs and thighs well flexed
and hips elevated from 6 to 12 inches
above the level of the table. If she be
a thin woman, when the speculum is intro-
duced in this position the air immediately
rushes into the bladder, distending it. But
this simple process will not succeed with
a fat woman. The most convenient and
universally applicable position is the knee-
breast posture, with the chest as close to the
table as possible and the back well bent in.
Frequently a more satisfactory posture is the
knee-breast, with the patient squatting a little
backward, so that the buttocks are in a
position directly over the calves of the legs or
the ankles instead of being vertically over
the thighs." The speculum is introduced
while the thumb presses on the handle of its
obturator. "On withdrawing the obturator,
air rushes at once into the bladder, distending
with an audible suction sound." . . .

The examiner wears one of the ordinary
head-mirrors used by laryngoscopists, by
means of which light from an electric or other lamp is directed
through the speculum into the bladder. To find the ureters,
which alone is what concerns us here, the speculum is moved

FIG. 200.

*Howard Kelly's
Ureteral Catheter (the
latest model has, at the
outer end, only a bulb
for attaching tubing).*

and withdrawn a little so as to bring its point over the trigone. "The interureteric ligament is sometimes marked as a distinct rounded transverse fold. By turning the speculum to the right or left about thirty degrees, with its end projecting 1 cm. into the bladder, the right and left ureteral orifices can be brought successively into view. The ureteral orifice usually appears as a little slit about 3 mm. long placed transversely with a slight horseshoe-shaped elevation around it, open on the inner side. Usually, with the woman in the knee-breast position, the ureteral orifice is found on the inner side of a decided eminence having the form of a truncated cone (mons ureteris). The ureteral orifice may at times appear as a little pit or hole in the mucosa, at other times as a rosette with the opening in the centre. If the observation is continued for a minute, a little jet of urine will be seen to spurt out of the ureter for two or three seconds. The ureter then closes, to be opened by another jet within the following minute."

Before making the examination, it is as a rule necessary to remove with the suction apparatus the few drachms of residual urine left; and during the examination it may be necessary again to remove the secreted urine.

"For a ureteral catheter I use a simple metal tube about 10 in. long, gently curved at its outer end, which is held in the hand so as not to obstruct the view during its introduction. The end is also enlarged a little, so as to hold a fine rubber tube slipped over it in washing out the ureter and kidney. The ureteral end of the catheter has a rounded point with three or four holes in it and a very slight curve at the end.

FIG. 201.

Howard Kelly's Ureteral Catheters for collecting Urine (a later model has rubber tubing attached).

" To introduce the catheter, the ureteral orifice is brought to about the centre of the field of the speculum, and the mirror and light are adjusted so that the head of the observer is not in the way as he introduces the catheter into the speculum and slides it on until its point rests in the ureteral slit. On pushing it in a little the sides of the opening separate, and it appears as a hole with the catheter lying in one side of it. The catheter must now be pushed out gently toward the side, stopping at once if the slightest resistance or obstruction is met. When it has reached the pelvic wall ($1\frac{1}{2}$ to 2 in. from the orifice) it must be firmly held while the speculum is slowly drawn out, disengaged from the urethra and pulled over its end."

The urine soon begins to flow from the catheter, coming intermittently in a few drops at a time. The average flow should be $\frac{1}{8}$th drachm per minute. Two catheters may be introduced, and thus it is possible to collect the secretion from each kidney at the same time for separate examination.

By this method not only is it possible to catheterise the ureters but to push bougies right up to the pelvis of the kidney, so diagnosing and even treating hydro-nephrosis and pyelitis. Also by pressing the speculum around the orifice of one ureter, which has been carefully cleansed by a small mop, the urine may be permitted to trickle out along the speculum, and so be collected without catheterising the ureter at all.

THE OPERATION.

The kidney may be removed in two ways :

(1) By incision through the loin—Lumbar nephrectomy.

(2) By incision through the parietes—Abdominal nephrectomy—Coelio-nephrectomy.

Lumbar Nephrectomy.—Several varieties of incision are recommended. Morris recommends " a transverse or slightly oblique incision, made somewhat nearer the last rib than in colotomy ; with this should be conjoined a second incision, running vertically downwards from the first, and starting from it about one inch in front of its posterior extremity." The special advantage

of the vertical incision is, that it affords increased facility for passing the ligature round the pedicle. Weir* made use of a lumbar vertical incision three inches from the spine, just below the twelfth rib, and extending to the crest of the ilium; and a second incision, transverse, varying in length according to requirements, and running from near the top of the vertical incision along the edge of the ribs. Simon's original incision was a vertical one; but in his case the kidney was not enlarged. Lucas † recommends an oblique incision, as for colotomy, supplemented by a vertical one carried along the outer edge of the quadratus, and extending from the last rib to the iliac crest. Klineberger used a curved incision, the convexity of which was upwards and outwards. Thornton, ‡ in a discussion on Dr. Walter's case of nephrectomy for cystic tumour of a floating kidney, thought that the operation of the future would be a vertical incision, farther out than Langenbuch's through the linea semilunaris; not entering the peritoneum, but pushing it, with the colon, inwards. Other varieties of incision have been described.

The lines of incision should be determined by the condition of the organ to be removed. A healthy kidney, or one but slightly enlarged and not adherent, may be removed through a simple oblique incision made between the ribs and the iliac crest. The upper extremity should be at least an inch distant from the last rib: the lower extremity may be carried close to the crest of the ilium; if the costo-iliac space is small, the line of incision may be curved forwards some distance.

FIG. 202.

Lucas's Knife for Nephrectomy.

* *New York Med. Journ.*, Dec. 27th, 1884.
† *Brit. Med. Journ.*, ii., 1883, p. 611.   ‡ *Brit. Med. Journ.*, ii., 1883, p. 615.

If the kidney is of large size, or if it is fixed by adhesions, more space is required both for its removal and for performing the necessary manipulations in enucleating it. In every case, the operation may be begun by the oblique incision. Through it the condition of the kidney may be ascertained, and, in cases of suppuration, a decision come to as to the advisability of giving nephrotomy a trial; while, if the kidney is to be removed, the best mode of enlarging the incision will be more accurately judged after seeing the amount of space provided by the oblique incision. Some form of transverse incision, starting near the lower extremity of the oblique one and carried towards the middle line as far as may seem expedient, will usually be found the best. It is made by the scissors cutting through the parietes at one stroke, and guided by the forefinger, which is pushed forwards through the cellular tissue, and keeps the peritoneum out of the way. The incision may be carried forward to any distance desired, the peritoneum being carefully elevated from the kidney surface, and pushed inwards.

The actual lines of incision are not of supreme importance. Any incision which gives plenty of room, and does not involve entering the peritoneal cavity, may be adopted. The incision described is that which I have found most suitable.

The incision being made, and all bleeding points having been secured, the kidney is separated from its connections. If there has been no inflammation, this will be found an easy proceeding; the forefinger of one hand, carried close to its capsule, readily enucleating the organ from its fatty bed. But if there has been much inflammation, the cellulo-fatty tissue may be very dense and very adherent, and enucleation may prove very difficult. In some cases, enucleation is simply impossible with-
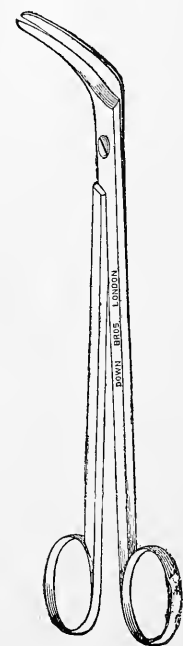
FIG. 203.

Lucas's Scissors for Nephrectomy.

out the use of a cutting instrument—scissors being best for this
purpose. An attempt may be made to enucleate the kidney
from its capsule, leaving the capsule behind ; but this also,
if there has been suppuration at many points, will be found a
difficult matter. Each case must be judged on its own merits.
It must not be forgotten that there is a limit to the amount of
force which may be exerted in the separation of adhesions
surrounding a kidney ; surgical manipulation ought never to
be carried into brute force. Very dense adhesions should be
divided by scissors ; forceps, where necessary, being placed on
the bleeding points. In cases where nephrotomy has been
performed, it is usually found that enucleation from the capsule
is more feasible than enucleation from the circumrenal fat. In
cases of old-standing suppuration, with great enlargement, the
vena cava and the aorta may be intimately adherent to the cap-
sule. One such case was recently met with in the post-mortem
room of the Bristol Infirmary ; here it was simply impossible,
after death, to dissect apart the vascular walls and the renal
capsule. In another case, for similar reasons, the organ could
not have been removed by any proceeding claiming to be recog-
nised as surgical. In such cases, where complete removal is
out of the question, an artificial pedicle, including some renal
tissue, may be formed at some distance from the middle line.
The tissue left will probably either atrophy or slough ; and the
danger of wounding vena cava or aorta will have been avoided.

The kidney having been freed, the next step is to secure the
pedicle. This is a proceeding demanding great care and
delicacy. A few surgeons recommend that the artery and the
vein should be ligatured separately. In many cases this will be
found impossible ; in none is it necessary. Indeed, the walls of
the vein or veins, by acting as a sort of padding, may add to
the safety of ligation, preventing the thread from slipping and
distributing the pressure on the artery or arteries. As a matter
of fact, the only deaths as yet recorded from secondary hæmor-
rhage were in two cases where the vessels were separately tied.
The vessels are ligatured in a body ; the ureter, separately.

The kidney is first most carefully raised out of its bed, and

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handed to an assistant, who holds it steadily in both hands, exerting no traction on the pedicle. The fingers of the left hand (or the right hand, as may be most convenient), surrounding the pedicle, isolate ureter and vessels as far as possible by teasing out the cellular tissue between them. Pulsation in the artery is a guiding sign of importance. A ligature of thick silk is carried, by an aneurism needle in the other hand, around the vessels, and tied. While the ligature is being tightened, all traction must be taken off the pedicle. The ureter, isolated as far as possible, is caught in a pair of compression forceps, and left to be dealt with as seems best afterwards. The kidney is now deliberately cut away, at a safe distance from the site of ligation, by successive snips of the scissors ; and while this is being done, all tension on the pedicle must be relaxed. An artery may be dragged through a very tight ligature which encloses other tissues ; and this artery, recoiling afterwards, may bleed. If it is impossible to bring the pedicle fully within sight, then a large catch-forceps should be placed upon it outside the ligature, and division made between forceps and kidney. Or a temporary ecraseur, of rope or wire, may be used for the same purpose. Every possible precaution should be taken against the occurrence of hæmorrhage.

The ureter is separated from the pelvis by a stroke of the scissors. If it is much thickened, and its mucous membrane ulcerated, either Thornton's plan of fixing the divided extremity in the parietal wound should be adopted or complete removal as low down as possible should be carried out. If it is fairly healthy, it may be ligatured and left in the wound.

In some cases of large suppurating kidney it may be impossible to manufacture a pedicle composed of vessels only at a safe distance from the aorta or vena cava. In this case the simplest plan is, to surround the base of the organ with a temporary ligature attached to an ecraseur, and cut away the diseased tissues close to it. Tait's temporary rope-clamp is very suitable for this purpose. If the kidney is very large, it may, while this compression is being exerted, be cut away in portions, to the great simplification of the operation. The

difficulty of delivering an enormous kidney through a lumbar wound is thereby avoided, and more important still, the risks of traction on the vessels are avoided. When the organ is shaved away down to the position of the temporary compression, the pedicle may be dealt with deliberately by ligation in any manner considered best.

There would seem to be no extra danger in placing the ligature quite close to the aorta or vena cava. But most surgeons would endeavour to give these vessels as wide a berth as possible —not only to avoid injury to their walls, but also to escape the risk of extension into their lumina of the thrombotic plugs.

A final examination is made of the pedicle and of the cavity of the wound. All blood-clot is removed, any bleeding points are secured, and the peritoneum is carefully examined, to make certain that it has not been torn. A peritoneal rent is at once closed by a continuous suture placed from the outside, which will cause accurate apposition of its serous surfaces. If the colon has been exposed on its retro-peritoneal aspect, it also must be examined for injury.

A large rubber drain is placed in the bottom of the cavity, and the wound sutured by deep and superficial stitches. The peritoneum, pushed backwards by intra-abdominal pressure, soon closes in over the large cavity. Primary healing is the rule; and the progress, as soon as the first dangers are over, is usually very rapid.

Abdominal Nephrectomy.—The incision may be made either in the ordinary way, through the linea alba; or, after the method introduced by Langenbuch, through the linea semilunaris on the side of the kidney to be removed. Langenbuch's method is now almost universally adopted. I would personally prefer an incision through the outer fibres of the rectus muscle, leaving the fascial tissues intact.

The length of the incision must be sufficient to admit the whole hand—at least four inches—even if the kidney is of normal size; if the kidney is enlarged, the length of the incision must be made to correspond. Its middle point is at the level of the

umbilicus. When the abdominal cavity is entered, a large flat sponge is inserted, to keep the intestines out of the way and to absorb effused blood. Before proceeding to remove the kidney, the state of the other will have been ascertained as accurately as possible by examination with the hand passed through the parietal opening.

The kidney is exposed by tearing through the peritoneum where it forms the outer layer of the meso-colon. The inner layer—that between the colon and the middle line—contains the vessels which supply the bowel, and incision through it may cause, and in fact has caused, gangrene of the gut. Two or three fingers, passed through this opening, enlarge it by tearing and stretching, and separate the front of kidney from the circumrenal fat. When a way has been opened to the renal vessels, these may be exposed, or at least brought nearer to the field of vision, by hooking up the peritoneal flaps with a retractor, which, in the hands of an assistant, at the same time makes the parietal wound gape. The vessels are carefully isolated with the forefinger. A ligature is passed round them with a blunt aneurism needle and tied. The ureter is caught in forceps, which are left attached. The organ is now completely separated rom its surroundings, the vessels are divided at a safe distance from the ligature, the ureter is cut through, and the whole mass lifted out of the wound. If there is any doubt as to the security of the ligature, a long catch-forceps should be placed on the end of the pedicle, while a second ligature is applied behind the first. In most cases double ligatures have been used.

The ureter is treated as in lumbar nephrectomy. If it is fairly healthy, it is ligatured, cleansed, and returned; if it is diseased, lined with thick granulations, and contains putrid pus, its divided extremity may be fixed in the wound, as suggested and practised by Thornton; or turned out through an opening in the loin, as suggested by Morris. In such cases as strumous pyelitis, where the disease often extends down the ureter, this extra-peritoneal treatment of the ureter lessens the chances of its becoming a new abscess-sac, and permits of its being irrigated and disinfected. Thornton's plan has been criticised, as inviting

the subsequent occurrence of intestinal obstruction by raising up a tense band between bladder and loin,—a not very likely result. Complete removal of the ureter has been carried out in such a case.

The cavity is finally cleansed, and examined for bleeding points. The peritoneal rent falls together naturally, and requires no suture. If pus or urine has escaped during the manipulations, a drainage tube should be placed in the bottom of the wound; otherwise, drainage is unnecessary. The parietal wound is closed in the ordinary way.

Choice of Operation.—Whether the lumbar or the abdominal method be selected in a given case, will depend on many circumstances. Firstly, there is the predilection of the operator. That men of such experience and success as Tait and Thornton should prefer the abdominal method, is a very strong argument in its favour. But the force of the argument is weakened, in so far as it refers to surgeons in general, from the fact that those men who prefer the abdominal operation are also men of very large experience in performing abdominal operations for other purposes. To most surgeons the lumbar operation would commend itself, as being more easy of performance.

Then there is the question of safety. The general mortality after the lumbar operation is considerably less than that after the abdominal. Out of 233 cases collected by Gross,* 111 by the lumbar method gave a per-centage mortality of 36.93, while 120 by ventral incision gave 50.83 per cent. mortality. Newman gives the mortality after lumbar nephrectomy as 30.5 per cent., and after abdominal as 47.1 per cent. It may, however, be reasonably urged against any conclusions drawn from these statistics, that the simplest cases were naturally selected for the lumbar operation, and the most difficult for the abdominal. There are no figures to show what mortality the abdominal method or the lumbar would have given, each in unselected cases. It is just possible that the abdominal method, in those cases where the lumbar was adopted, would have given even better results. Indeed, in the hands of a few operators, with cases that were certainly far from being simple, the results in

* *Amer. Journ. Med. Sc.*, July, 1885.

abdominal nephrectomy are far ahead of the average in lumbar nephrectomy.

We cannot ignore these facts, and compare the value of general lumbar nephrectomies with general abdominal nephrectomies by figures alone. All that can be said is, that, so far, the general superiority of the one to the other has not yet been proved; and the surgeon is left absolutely to his own discretion, in each case, as to the operation he shall adopt.

Looking at the mechanical details of the operations themselves, we find that certain cases are most suitable to one method, and some to the other. Generally speaking, it is possible before operation to make a sound selection; but sometimes it is not.

By the lumbar method, less space is given for removal of the kidney; the important procedure of ligature of the pedicle is carried out at some distance from the surface, and frequently out of sight; and there is not the same facility in dealing with bleeding points in the tissues from which the kidney has been enucleated. On the other hand, the lumbar method is an extra-peritoneal operation; it gives more facility for the separation of strong adhesions behind the kidney; and in the case of its being unwise, as in abscess, or in tumour infecting the surrounding tissues, to proceed to removal, it is less serious to the patient. In the case of abscess, it has the further advantage of permitting of treatment by incision and drainage, without serious risks of peritonitis.

Langenbuch's operation is, in its way, a perfect surgical procedure, securing its aims by a minimum of injury to surrounding tissues. In the linea semilunaris or to the inside of it, the advantages of avoiding division of muscles are secured; and by tearing through the peritoneum in front of the colon, the vitality of the bowel is not endangered. It gives plenty of room for the removal of the kidney. Lastly, it secures the all-important advantage of giving information as to the condition of the alternate kidney. Its disadvantages, in addition to the opening of the peritoneal cavity, are chiefly the difficulty of separating adhesions behind a large kidney, and the dangers from rupture of abscess-cysts inside the cavity.

Bearing in mind the advantages and disadvantages peculiar to each operation, we can roughly specify the cases most suitable for each.

By the lumbar method, all small kidneys may be removed. These include ordinary examples of ureteral fistula which cannot be cured by a plastic operation, and cases of wounds of the kidneys in which there is urinary extravasation or suppurative disintegration of tissue. It ought to be selected for all small growths of the kidney, and particularly if it is movable. It is best employed for all enlargements containing fluid—hydatid, hydro-nephrotic, or purulent—in which incision, with drainage, has not produced cure. In cases of calculus in which the renal tissue is completely disorganised, the lumbar method is the best.

The ventral incision is most suited to large non-adherent solid tumours, and to those movable kidneys which have become diseased and are unsuitable for nephropexy. In very fat subjects, the ventral incision may be easier than the lumbar, as permitting of easier approach. In very lean subjects, both operations are much facilitated—the lumbar more, perhaps, than the ventral.

A word must be said on the plan recommended by Thornton, but now abandoned by him, which Morris has called " Lateral Retro-peritoneal Nephrectomy." In this plan, the incision is made further outwards than the linea semilunaris—so far out, in fact, as to permit exposure of the kidney by the peritoneum being pushed aside without opening it, as in ligature of the external iliac. The advantages of making the incision in the linea semilunaris are perhaps more ideal than real : an ab- dominal section is about as easily performed by division of muscles as of fasciæ ; the bleeding is easily controlled, and the wounds unite just as readily. If there is any advantage in going further outwards, the division of muscle need not deter us. In cases of considerable enlargement of the kidney, for which only this method would be selected, the peritoneum is pushed inwards, and reflexion of it, without entering the abdomen, is easy enough. It is doubtful, however, if by this lateral incision it is as easy to deal with the pedicle as in Langenbuch's operation.

OPERATIONS ON THE URETERS.

Surgical Anatomy.
Injuries to the Ureter.
    Diagnosis.
    Operation.
Calculi in the Ureter.
    Diagnosis.
    Operation.
        In Lower Ureter.
        In Middle Ureter.
Wounds of the Ureter.
Implantation of Ureter into Bladder.
Implantation of Ureter into Bowel.
Implantation of Ureter into Skin.
Ureterectomy.
Irrigation of Ureter.

Operations are performed on the ureters for stricture, for calculus, for injuries, for fistula, and for tubercular and suppurative disease. Such operations have not been numerous, and the relative values of the operative methods have not been finally determined. Still a gratifying, almost surprising, measure of success has followed most of the methods adopted, and it is now possible to give definite advice as to operative details.

Until recently no attempt has been made to draw general conclusions from the isolated reports of individual cases. At the annual meeting of the American Surgical Congress, held in May, 1894, the Surgery of the Ureter was included amongst the subjects for discussion. The paper of Christian Fenger of Chicago,* which introduced the discussion, is an elaborate *resumé* of the whole subject; and is equally valuable for the completeness of the reviews of the work done, and for the soundness of judgment displayed in selection of methods. Individual operations will be

* *Ann. Surg.*, Sept., 1894.

credited to their originators in the separate descriptions of the operations.

The excretory duct of the kidney may be considered as originating in the calyces which individually embrace the papillary extremities of the pyramids of Malpighi. From these, intermediary tubes (infundibula) converge on two large tubes (superior and inferior pelvis), which coalesce to form the common pelvis. (See Fig. 182, p. 800.) At the bottom of the common pelvis the ureter proper begins, and continues of fairly uniform calibre along its course to the bladder.

In *structure* the ureter may be described as a fibro-musculo-mucous canal, flattened antero-posteriorly, and about one-sixth of an inch in diameter. The wall is about one twenty-fifth of an inch in thickness. The mucous lining is plicated, and consists of several layers of transitional epithelium, continuous with the epithelium lining the papillæ above and the bladder below. The mucous surfaces lie in contact unless the ureter is distended by passing urine. The muscular coat usurps half the thickness of the whole wall, and has an external layer composed of annular fibres and an internal layer of longitudinal fibres. At the entrance into the bladder the circular fibres are increased to form a sort of special sphincter around the orifice, while the longitudinal fibres are spread out over a triangular area in the base of the bladder pointing towards the internal orifice of the urethra. The fibrous covering is not very dense, is about the same thickness throughout, and is continuous above with the fibrous capsule of the kidney, and below with the fibrous tissue surrounding the bladder. The fibrous envelope is more firmly attached to the peritoneum than to the underlying tissues. Thus, in extravasations stripping the peritoneum the ureter is always raised with that membrane, and is to be found, not at the bottom or the middle of the extravasation, but always directly under the peritoneum at the top. This, as will be seen, is a matter of great surgical importance.

The *course* of the ureters (Fig. 204) from kidney to bladder is

about twelve inches in length, more or less, according to the size
of the individual.   At their commencement they lie about three
inches apart ; they converge a little as they descend, so that at
the brim of the pelvis they are about two inches apart.   In the
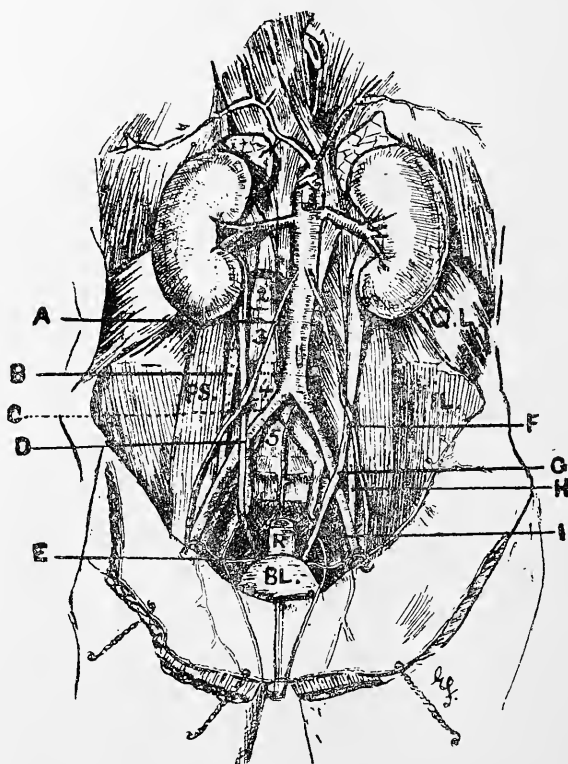
FIG. 204.

Course and Relations of Ureters in the Male (FAWCETT).

A.   Spermatic artery (right).
B.   Psoas parvus (right).
C.   Disc between 4th and 5th lumbar vertebræ : the point where the spermatic vessels
cross the right ureter.   This dotted line from the highest point of the iliac crest to the ureter
is four inches in length.
D.   Right ureter crossing the bifurcation of the common iliac artery.
E.   Right obliterated hypogastric artery crossing vas deferens.
F.   Left spermatic artery crossing ureter, a little lower than on right side.
G.   Left ureter at bifurcation of common iliac.
H.   Left psoas parvus.
I.   Left obliterated hypogastric artery.
2, 3, 4, 5.   Placed on the bodies of the 2nd, 3rd, 4th, and 5th lumbar vertebræ, vena
cava removed.
Q.L. Quadratus lumborum. IL. Iliacus. PS. Psoas magnus. R. Rectum. BL. Bladder.

pelvis they diverge, but again converge to the base of the bladder
see under "Surgical Anatomy of Uterus," p. 278, Fig. 66).

The abdominal portion of the ureter lies on the psoas muscle covered by its fascia, is in relation with the genito-crural nerve and the psoas parvus, and crosses the common iliac artery near its bifurcation. Near the level of the umbilicus each ureter is crossed obliquely by the spermatic vessels. The right ureter lies in its lower
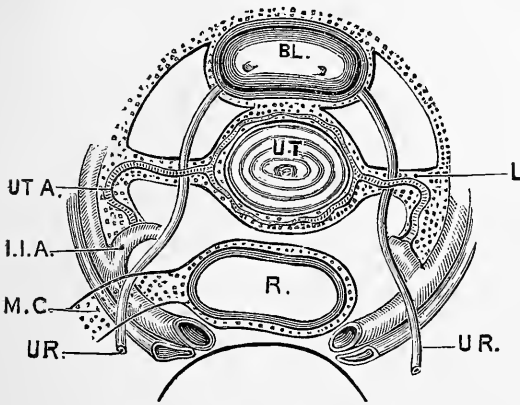
FIG. 205.

Diagram showing Course and Relations of Ureters in Pelvis.
The diagram is composite, partly sectional, partly
a bird's-eye view.

BL. Bladder.   **UT.** Uterus.   **R.** Rectum, dilated.   **L.** Broad
ligament (right).
   UT.A. Uterine artery.   **I.I.A.** Internal iliac artery.
   M.C. Meso-colon (sigmoid mesentery) crossing ureter near where
it dips into pelvis.
   UR. UR. Right and left ureters, showing lateral sigmoid bending.
The dipping bend into the pelvis is not shown. The dotted areas
represent sub-peritoneal areolar tissue.

abdominal portion close to the vena cava; the left ureter does not
lie so close to the aorta, being about half an inch distant at its
closest point.

In the pelvis, after crossing the bifurcation of the common
iliac at the sacro-iliac synchondrosis, the ureter turns outwards to
lie on the obturator internus fascia below the psoas; and then leaves
the pelvic wall to curve towards the bladder. Here, in the male
(Fig. 204) it is crossed above and to the inside by the vas
deferens, and lies under the free end of the vesicula seminalis.
In the female it crosses under the uterine artery (Fig. 205) in the
broad ligament, runs parallel with the cervix uteri, half an inch
behind it, crosses obliquely the upper third of the vagina, and
pierces the bladder near the middle of the vagina.

In the *bladder wall* the course of the ureter is about half an inch in length, and runs obliquely through the coats converging to the internal opening of its fellow, from which it is distant about three-fourths of an inch, and the same distance from the internal orifice of the urethra.

Three *constrictions* in the course of the ureter are described at which stones are liable to be arrested. One is at the top, where it joins the renal pelvis; one where it crosses the iliac artery to dip into the pelvis; and one just before it enters into the bladder. The last is probably more a muscular contraction than a true narrowing of the calibre of the tube.

Certain *variations* in the anatomy which may be of surgical importance are described. Instead of a single pelvis there may be two, and with this a duplication of the ureter for the whole or part of its course. If there is duplication of part of the ureter, there may be a sort of pelvis where they join. Occasionally the ureter bifurcates after leaving the pelvis single, and each half may have a separate entrance into the bladder, as may happen in complete double ureter. Sometimes, in the female, the ureter is implanted not into the bladder but into the urethra near to its orifice, or into the side of the vagina. This last variation is associated with incontinence of urine, and a successful operation has been performed for the relief of this condition.

Landmarks indicating the course of the ureter have been laid down. Tourneur (quoted by Fenger) gives it a vertical course from the edge of the kidney to the brim of the pelvis. It passes over the brim four and a half centimetres ($1\frac{3}{4}$ in.) from the middle line. This point of crossing is marked on the parietes by the intersection of two lines—a horizontal one drawn between the anterior superior iliac spines, and a vertical one passing through the pubic spine. If a dilated and tender ureter can be felt anywhere through the parietes, it will be by pressure at this point. In the pelvis, the ureter may be palpated in the male by the rectum; in the female, by vagina or rectum, or both combined, it may be palpated for nearly two inches.

For surgical interference the ureter may be reached by trans-peritoneal or retro-peritoneal route. A median or slightly lateral

incision will overlie the ureter through its whole length; and any point in its course may be reached by pushing intestines to one side. Retro-peritoneal operation is more difficult. The abdominal portion may be exposed by a prolonged nephrotomy incision from the last rib skirting the anterior superior spine of the ilium and going towards the middle of Poupart's ligament. Such incision would be limited to the parts where the disease to be remedied lies. The peritoneum may be undermined from this incision without great difficulty as far as the pelvic brim: below this, except in very thin or very small patients, undermining of peritoneum could scarcely be done. To reach the pelvic portion, an osteo-plastic resection of the sacrum would expose the ureter and give ample space for operation. In women, operations through the vagina for fistula and for stone have been successfully performed.

INJURIES TO THE URETER.

The ureter may be injured directly by impact of bullet, or puncture by knife; or indirectly by a blow through unbroken parietes. Of the former only very few cases are recorded and no operations. Of the latter, or subcutaneous ruptures, sixteen had been related up to Fenger's writing. The force causing rupture is usually of some violent nature, such as the kick of a horse over the region of the ureter, or being run over. In two cases the injury was caused by over-stretching, the ureter being torn from the kidney or in its upper portion. When ruptured by a blow, the ureter is supposed often to be crushed on the transverse process of the first lumbar vertebræ.

Diagnosis.—The symptoms are not at first severe. In three cases there was very slight and transient hæmaturia; this was not noted in any of the others. The first indication of ureteral rupture is swelling from escape of urine into the areolar tissue around the injury, and this does not appear till from one to as many as seven weeks. This swelling may usually be palpated through the abdomen, and is described as round, oblong, or sausage-shaped, following the course of the canal.

Operation.—As diagnosis cannot with certainty be made till swelling appears, operation will in the first place consist in puncture and evacuation of the extravasated urine. The operation of election in a certainly diagnosed case would probably be incision and drainage through an incision in the loin, as was done by Allingham.* Puncture once and several times repeated has also been successful; as have incision and drainage through the abdominal cavity. Obliteration of the ureter and stricture are liable to arise in untreated cases; and in those treated by drainage, septic pyelitis has been started from the resulting fistula, necessitating nephrectomy in five cases.

Undoubtedly the best treatment would be to suture the rent in the ureter. But the diagnosis is rarely made till the parts are greatly swollen, when localisation of the rent would be very difficult; still it might be possible, and is certainly worth trying in cases that do not heal after incision and drainage.

CALCULI IN THE URETER.

Calculi may be arrested in any part of the ureter; but they are found most frequently in its upper portion, at the junction with the renal pelvis; less commonly about the middle and at the entrance into the bladder.

Diagnosis.—Stones embedded in the upper and lower extremities of the ureters usually protrude into the pelvis of the kidney and into the cavity of the bladder. The former is usually discovered during an operation for stone in the kidney or for hydronephrosis. The latter is discovered by the vesical sound. Diagnosis where the stone is situated elsewhere than at the extremities is not easy. A history of repeated attacks of renal colic, with its associated signs; the appearance of hydronephrosis, and the existence of a painful spot tender on pressure somewhere in the course of the ureter, suggest calculous impaction. In the lower ureter a stone may be detected by palpation through the rectum in the male, and by vagina and rectum in the female. This has been done on

* *Brit. Med. Journ.*, Mar. 28, 1891.

several occasions, and successful operations have followed the diagnosis. Calculous impaction in the middle of the ureter it is impossible to diagnose with certainty. Certain diagnosis can only follow coeliotomy and direct palpation.

Operation.—The operation will vary according to the seat of the stone.

A. *In the Lower Ureter.*

Removal through the bladder of a stone bulging through the ureteric orifice has been done five or six times by dilatation of the urethra and twice by supra-pubic cystotomy. It may be possible to grasp the stone and pull it out without incision; if this is impossible, a small incision, with careful dilatation of the orifice by forceps or probe, will serve to liberate the stone. The vesical wound may or may not be sutured, according to the judgment of the surgeon.

Removal through the rectum has been successfully performed in one case.*

Removal through the vagina has twice been successfully performed. In one case, by Emmett,† the vaginal wall was divided by scissors, and the opening was closed by suture. In the other case, by Cabot,‡ the stone was felt in the left broad ligament close to the uterine cervix, and direct incision was made on it. A fistula remained for four months.

B. *In the Middle Ureter.*

Here entrance must be made through the abdominal parietes; and this may be done either extra-peritoneally or trans-peritoneally. The pelvic ureter, except in very thin or very small patients, cannot be reached without extensive denudation of peritoneum by the extra-peritoneal method : here the operation of choice is trans-peritoneal. Between the kidney and the true pelvis the ureter may be reached by a retro-peritoneal operation, and this is the method of selection here.

Retro-peritoneal Ureterotomy.—Five such operations have been

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* Ceci. *La Riforma Medica*, Sept., 5, 1887.

† *Principles and Practice of Gynæcology*, 1884.

‡ *Boston Med. and Surg. Journ.*, Dec. 25, 1890.

performed, all successful.   In one case by Twynam[*] diagnosis was made of stone in the right ureter below the pelvic brim after coeliotomy.   Three weeks later, retro-peritoneal ureterotomy was done through an incision in the right iliac region, the stone removed, and the ureter sutured.   The patient was a boy aged eight.   In Cabot's case[†] the stone was found two inches below the kidney by the lumbar renal incision.   The wound was not sutured, but healing took place.   In the other cases stones were thought to be in the kidney, but were found to be in the ureter. In each case longitudinal ureterotomy not followed by suture resulted in healing.

Intra-peritoneal Ureterotomy.—This has been done twice, by Cullingworth and by Arbuthnot Lane.   In Cullingworth's case[‡] a diagnosis of enlarged ovaries in Douglas' pouch was made, and stone in the ureter was found.   Pus escaped on removal of the stone ; the wound was sutured and the pelvis drained. The patient died in eighty hours.

In Lane's case,[||] eight months after an exploration of the kidney, direct ureterotomy with closure of the wound by continuous suture was followed by recovery.

In some cases where the stone is lodged near to the upper extremity of the ureter it is possible to push it upwards into the pelvis.   Fenger tried unsuccessfully to push a stone into the pelvis by a needle passed through the wall of the ureter. But he does not consider the procedure important if the stone can be removed by extra-peritoneal incision.

WOUNDS OF THE URETER.

Incised wounds of the ureter may be longitudinal or transverse.   *Longitudinal intra-peritoneal wounds* should be sutured by simple Lembert sutures, and these should be reinforced by infolding of peritoneum, or by fixing an omental graft.   *Longitudinal extra-peritoneal wounds* have been found in extraction of calculus to unite without suture.

[*] *Trans. Clin. Scc. Lond.*, vol. xxiii., 1890.   [†] *Loc. cit.*
[‡] *Trans. Path. Soc. Lond.* 1885, vol. xxxvi., p. 278.   [||] *Lancet*, Nov. 8, 1890.

Transverse wounds tend to gape, and do not easily unite after direct suturing. Complete transverse wounds are best treated by Van Hook's* method of invagination—*Uretero-ureterostomy*, as Kelly named it in describing a brilliant operation by himself. The steps of the operation are thus described by Fenger (Fig. 206) :—

" (1) Ligate the lower portion of the tube one-eighth or one-fourth of an inch from the free end. Silk or catgut may be used. Make with fine sharp-pointed scissors a longitudinal incision, twice as long as the diameter of the ureter, in the wall of the lower end, one-fourth of an inch below the ligature.

" (2) Make an incision, with the scissors, in the upper portion of the ureter, beginning at the open end of the duct and carrying it up one-fourth of an inch. This incision insures the patency of the tube.

" (3) Pass two very small cambric sewing needles armed with one thread of sterilised catgut through the wall of the upper end of the ureter, one-eighth of an inch from the extremity, from within outward, the needles being from one-sixteenth to one-eighth of an inch apart, and equidistant from the end of the duct. It will be seen that the loop of catgut between the needles firmly grasps the upper end of the ureter.

" (4) These needles are now carried through the slit in the side of the lower end of the ureter into and down the tube for half-an-inch, where they are pushed through the wall of the duct, side by side.

" (5) It will now be seen that the traction upon this catgut loop passing through the wall of the ureter will draw the upper fragment of the duct into the lower portion. This being done, the ends of the loop are tied together securely, and, as the catgut will be absorbed in a few days, calculi do not form to obstruct the passage of the urine.

" (6) The ureter is now enveloped carefully with peritoneum, . . . provided that an intra-peritoneal operation has been done."

The value and safety of this admirably-conceived operation

* *Journ. Amer. Med. Assoc.*, Mar. 4, 1893.

was first proved by Van Hook in experiments on dogs. He was led to investigate the subject from a study of the very discouraging
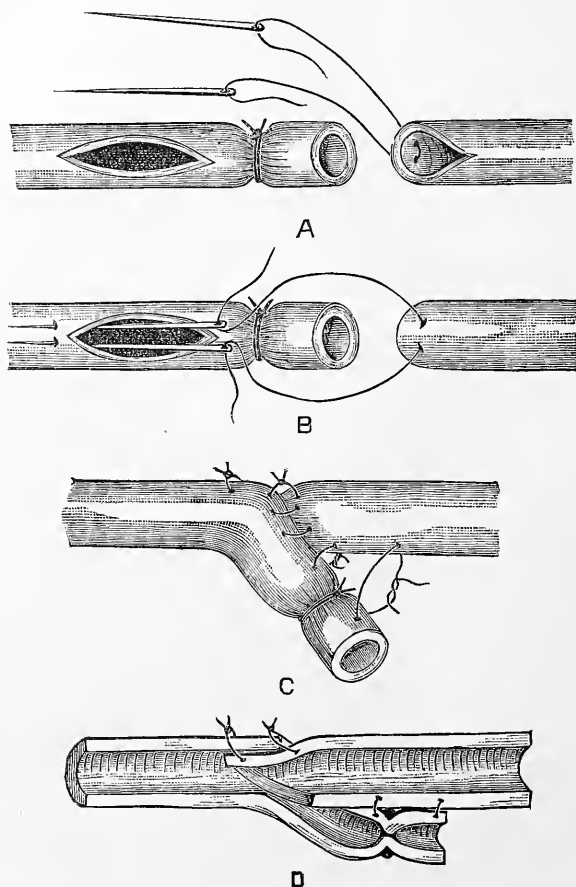
FIG. 206.

Van Hook's Operation of Uretero-ureterostomy. (The figures should have been turned in the opposite direction.)

A. Vesical portion of ureter tied, and slit made in wall below ligature. Renal end slit and traction suture introduced.
B. Needles with traction suture passed into slit in vesical portion and carried through walls.
C. Renal portion invaginated into vesical, traction sutures tied; additional sutures extra-mucous, placed.
D. View of **C** in median longitudinal section.

result got by Tuffier in his experiments on the union of ureteric wounds by suture. Van Hook's experiments were repeated by Bloodgood, with equally good results. When Kelly, during an operation for myomectomy, accidentally divided the ureter and at once performed uretero-ureterostomy, getting a perfect result, the value of the method was at once proved.

Implantation of the Ureter into the Bladder.—Where, from loss of substance, union of the divided ends is impossible, the ureter may occasionally be implanted into the bladder. This is best done by intra-peritoneal operation on the lines laid down by Van Hook. The cases of Novaro and Krug and Penrose, related by Fenger, practically illustrate the difficulties and success of the method. For uretero-uterine and uretero-vaginal fistulæ this operation should displace nephrectomy and kolpokleisis and hysterokleisis. Uretero-cystostomy should also be performed for those rare cases where there is a congenital opening of an abnormal ureter in the vagina or urethra. The possibilities of uretero-cystostomy in a specially difficult case are successfully illustrated by Kelly.* Here the end of the ureter was pulled through the bladder incision by a long forceps carried through the urethra, and fixed by sutures passing through all the coats of ureter and of bladder except the mucosæ. To permit the bladder to be pulled upwards separation of the viscus from the pubes had to be carried out. The ureter had to be separated from the pelvic brim downwards from a bed of adhesions left after a kolpo-hysterectomy for cancer.

Implantation of the ureter into the bowel has been many times performed with success experimentally; but the objections to the method, as frequently causing backward infective nephritis, are so strong, that it is not to be recommended. Chaput has described a fairly successful case in the human subject.

Implantation of the ureter on the skin may be justified to save death from anuria caused by pressure on the ureter, if no other measure is feasible. Le Dentu performed the operation for

* *Bull. of Johns Hopkins Hospital,* vol. ii., p. 27.

anuria in a case of cancer in the pelvis. Great loss of substance of the ureter might temporarily be treated by fixation of the renal extremity in the parietal wound, and subsequent nephrectomy ; or by some such plastic operations on skin or bladder as Rydygier and Van Hook have suggested.

Ureterectomy.—Reynier* describes a case of removal of the whole of one ureter for suppurative disease. Nephrectomy was performed for advanced pyo-nephrosis, the ureter being fixed in the lower part of the wound. Pus continued to flow from the ureter through the wound and into the bladder. The lumbar wound was enlarged and twelve centimetres of the upper end were removed. Still suppuration continued. Six months after the first operation the rest of the ureter was removed by a retro-peritoneal operation. A complete cure resulted. Kelly has, at the operation of lumbar nephrectomy, resected the whole of the ureter by a retro-peritoneal operation, turning the divided stump through an opening made in the vaginal vault.

The advantages of this operation are likely to be most conspicuous in tuberculous cases. The possibility of curettage, or of completely excising a tubercular or greatly thickened ureter as part of the operation of nephrectomy, would probably suggest themselves to the operating surgeon, to be accepted or rejected according to the circumstances of the case.

Irrigation of Ureter and Pelvis of Kidney.—Howard A. Kelly† has successfully shown how it is possible, through the vesical route by the insertion of ureteral catheters to apply lotions to the mucous membranes of the urinary tract. In his case the lower end of the left ureter was strictured, and above it was a collection of pus apparently gonorrhœal in origin. Repeated catheterisation and irrigation cured what was a painful and troublesome condition. It need scarcely be said that the possibility of treating pyelitis by this method opens up wide and important questions in treatment.

* Abstract in *Brit. Med. Journ.* from *Mercredi Med.*, Feb. 22, 1893.
† *Bull. Johns Hopkins Hospital*, vol. vi., No. 47.

Section IX.

ABDOMINAL OPERATIONS ON THE URINARY BLADDER.

SUMMARY.

ABDOMINAL OPERATIONS ON THE URINARY BLADDER.

In this section are considered such operations on the urinary bladder as are performed through the abdominal parietes. Most of these are included in the term supra-pubic cystotomy; but an operation of excision—cystectomy—is added. Operation for closing wounds in the bladder-wall—cystorraphy—is dealt with in the special section devoted to wounds and injuries of the viscera.

Supra-pubic Cystotomy.

I have adopted this name for the operation to be described because it is the one generally used. Epicystotomy is not definite enough : it might be applied to the gall-bladder as well as to the urinary bladder. Hypogastric cystotomy is the name I prefer : it is sanctioned by historic usage (cystitomia hypogastrica) ; it is the name most commonly used in France (taille hypogastrique) ; and, as naming the operation from the region in which it is performed, it runs parallel with a similar operation performed in another region—the perineum. But there is no strong objection to the term adopted, and, as I have

said, it is the one best known. The "High Operation" (Sectio alta) is a name frequently employed.

HISTORY.

In this, as in other historical enquiries, we have to discriminate between the man who ignorantly stumbled on the invention, and him who knowingly elaborated it; a third individual, who follows, imitates, modifies, or perverts, also requires consideration.

It is a curious fact that Pierre Franco (or de Franco, as he is sometimes named), the surgeon who first performed the operation, deserves no credit as its inventor; while its real inventor, Roussetus, never performed it. Franco was a surgeon who practised at Tourrieres, in Provence, and at Lausanne, during the middle and latter portion of the sixteenth century. In 1556 (not 1561—a later edition—or 1581, as is sometimes stated), he published at Lyons a book on Hernia.* A re-impression of this first edition was printed during 1884 in the *Revue de Chirurgie.* In the course of his narrative he makes the following "reciteray": "I will recite what once happened to me, intending to extract a stone from a child of two years old, or thereabout; in which, having found the stone, of the bigness of a hen's egg, or very near, I did all I could to bring it down [on the gripe], and finding that I was not able to bring it forward by all my endeavours, the patient being exceedingly tormented, and also the parents desiring that he should die rather than live in such misery; add to this, that I was not willing to be reproached with not being able to extract it (which was great folly in me), I determined, with the importunity of the father, mother, and friends, to cut the said child above the os pubis, since the stone could not fall down; and he was cut above the pubis, *a little on one side (un peu a costè)*, upon the stone; for I lifted it up with my fingers, which were in the anus, and on the other side holding it down, by the hands of a servant, which pressed the belly upon the stone, by which means

* *Petit Traité sur lés Hernies.*

the stone was extracted, and a little after the patient was cured (notwithstanding he had been very ill), and the wound healed. However, I do not advise any man to do the like." This is Cheselden's very correct translation of Franco's words.*

In 1590 Roussetus published his great work on Cæsarean Section, in which he gave a minute and accurate account of the anatomy of the parts concerned. Roussetus was the greatest physician of his day, possessed of an insight and knowledge which came very near to being genius. It is not surprising, therefore, that his studies in the anatomy of Cæsarean Section suggested the hypogastric route for entering the bladder. Roussetus knew of Franco's operation, and sharply censured him for dissuading others from following in his footsteps, while he sensibly combats the generally received opinion that wounds of the bladder were necessarily fatal. Finally, he elaborated the operation which he recommended by experimenting on the dead body; and this operation is, to all intents and purposes, the operation as it is performed to-day. The patient is laid on his back, the bladder is filled with milk, or barley-water, or a "vulnerary decoction," by means of a syringe which fits on to a silver catheter; the penis is grasped by the hand of an assistant, or tied by a "soft

* I give Franco's own words because, in the only recent English monograph on the operation (Sir Henry Thompson's), the method Franco employed is said to have been "to inject the bladder forcibly with water, the presence of which was insured by the assistant grasping the penis during the operation, and to dissect the bladder in the median line without a staff, opening the organ at the anterior aspect behind the symphysis." Franco distinctly says he did *not* cut in the median line, and his simple words can scarcely be elaborated into describing injection of the bladder and grasping the penis. Thompson's historical remarks are in other respects open to criticism. Thus, he confuses John Douglas, the surgeon who first operated, with his brother, James Douglas, the physician who first publicly brought forward the operation. The sentence (p. 9): "About this time several provincial surgeons published cases of the high operation, such as Pye and Thornhill of Bristol, Middleton and Macgill of Edinburgh, 1722–24," contains several errors. Middlelon was not of Edinburgh, but of Bristol, and he was not a surgeon, but a pure physician of the old-fashioned type, who probably never performed an operation in his life. It happened that he wrote for his friend and colleague, Thornhill the surgeon, the work to be presently described. A copy of this work (annotated apparently by the author) is now before me, and is dated 1727.

twist of cotton." He then accurately describes the supra-pubic incision, and the mode of exposing the bladder. The puncture in the bladder is made by a sharp-pointed, sickle-shaped knife; through this puncture a curved, probe-pointed knife, blunt at the point, so as to pull the bladder upwards, while it did not cut it, is insinuated to enlarge the incision. An assistant pushes the stone forwards with his finger in the anus in men, and in the vagina in women, and the surgeon extracts the stone by fingers, forceps, or scoop, as seems most convenient. An alternative method, to meet certain cases of difficulty, is to use a greatly curved and furrowed sound, on the point of which the incision into the bladder may be made. He thus anticipates certain subsequent procedures. Gradual distension of the bladder by ligating the penis and preventing the discharge of urine, he speaks somewhat dubiously about. It is physiologically sound, but practically intolerable.

Hildanus (1682) and Dionis (1714) finding it necessary to introduce a description of the operation into their works, did so, but without discrimination or even accuracy. Bonnet, a surgeon to the Hôtel Dieu, previous to this time, is said, chiefly on the authority of Tolet, to have operated by the high method; but he has left no literary proof to this effect. Simon Pietre, a Paris physician, wrote a short treatise in favour of the operation in 1635; and various references in general works subsequent to this time would seem to show that the subject was simmering in the minds of surgeons in Paris. At length Francis Collet was authorised to make experiments and report to the faculty at Paris; he reported unfavourably, and the operation was pro-hibited. Elsewhere a few stray operations were performed, rather from necessity than choice. Thus, Groenvelt, a Dutch surgeon, who wrote a treatise on Lithotomy, in English, in 1710, relates how he was once driven to perform the operation. Proby, a Dublin surgeon, published in the *Philosophical Transactions*, in 1700, an account of a case in a woman where, having failed to remove a long pin through the urethra, he cut down on the point, which was made to bulge over the pubes, and removed it in this way. These and similar operations had no influence on

the advancement of the operation, and it may be said steadily to have declined in favour till 1718, when the brothers Douglas took it up.

On January 23rd, 1718, Dr. James Douglas read a paper on the high operation for stone before the Royal Society, of which he was a Fellow. No doubt he, the physician, wrote on behalf of his brother John, the surgeon and lithotomist to Westminster Hospital; it was a common practice in those days for the cultured physician to do the literary work of the practical surgeon. In 1723 John Douglas published his treatise on the operation. Douglas was truly an inventor. When he began working at the operation he was ignorant of Roussetus's work, although he knew of Franco's bungling operation. The name he adopted, "Lithotomia Douglassiana," clearly indicates the position he assumes; and its admission by his compeers shows that they did not grudge him the title of inventor. The brothers were anatomists and scientific men of a high order, and they set about elaborating the anatomical basis of the operation in a thoroughly workmanlike manner. He describes his method in ten pages, and relates three cases, with drawings of the stones. The bladder is to be filled with warm water; the catheter being withdrawn, the assistant instead of grasping the penis bends it " down towards the anus, which will hinder the water from spurting out, and also keep his hand out of the way." The rest of the operation is essentially that of Roussetus. He makes the error of advising the completion of the incision into the bladder by running the knife upwards towards the fundus, whereby the danger of penetrating the abdomen is increased. He points out the superiority of forceps to fingers in withdrawing the stone, as the fingers take up more room. Douglas's patients were shown at the Royal Society, and their fame soon spread. He had a good many followers in England, some of whom wrote treatises on the operation. The most important of these are Cheselden of London and Thornhill of Bristol.

Cheselden must have been familiar with Douglas's work before Douglas wrote his treatise, for in 1723 he wrote his book on the high operation ; and having greater opportunities of putting the

operation into practice, he was able to publish nine cases of operation. His description of the operation occupies ten small pages; the rest of the book is occupied with descriptions of his cases and dissections, and translations of the writings of Roussetus, Le Mercier, Hildanus, and others. Cheselden gives Douglas the credit of being, if not "the inventor, surely the first man that ever practised it upon living bodies." Cheselden's description of the operation, though short and somewhat defective, is clear and practical. It differs in no important point from Douglas's.

The next important name in the history of the operation is that of Thornhill of Bristol, who performed his first operation in February, 1722. When his work was published (by his friend and colleague John Middleton, physician) in 1727, he had operated on at least fifteen cases. In Thornhill's (or Middleton's) treatise, the description of the operation, with some preliminary anatomical matter, occupies 23 quarto pages; and his cases, criticisms, and plates occupy 47 pages more. The description of supra-pubic lithotomy as performed by Thornhill is marvellously good. From his description of how the assistant is to hold the penis, "with a rag between the fingers and thumb that it may not slip;" his warning against over-distension of an ulcerated bladder; his accurate description of the contraction of the ends of the recti, and how this may be obviated; the risks of cutting upwards; the manner in which the peritoneal fold is pushed downward by straining; how to keep up the collapsing bladder after it is incised; and, more particularly, by his fertility of resource in treating his cases and their complications: one cannot avoid the conclusion that Thornhill was in his own time, and, indeed, for a century and a quarter later, the best exponent of supra-pubic lithotomy. He had greater experience than any of his age; he showed a finer appreciation of the difficulties and peculiarities of the operation; and undoubtedly, as a perusal of his cases must show, he exhibited more daring, and at the same time more caution, than any of his predecessors.*

* The excellence of Thornhill's work so impressed me, that I have taken a good deal of trouble in elucidating his history. Fortunately, there are ample

To give an idea of the keenness of Thornhill's insight into
the essentials of the operation, I quote the following remarks,
which appear as a foot-note in his work (p. 17): " I was in hopes
that the place for the puncture might be fixed to the satisfaction
of everybody, by searching gently with the finger for the
insertion of the urachus in the bottom of the bladder, which in
an adult subject I have observed to be prominent, like a little
knob, pretty firm, and as big as a large pea, only somewhat
flatter; and the finger being placed upon it, the puncture might
be made below it with an absolute certainty. But I find this
direction is fallible in live subjects, where the fibres being all in
action, the part seems so equally tense, that it is hard to
distinguish the insertion of the urachus. However, I mention
this as a theory, which perhaps may be improved, and in adults
is not entirely to be neglected." This is a highly important
observation which, so far as I know, has never been made
before in respect of this operation. And it is literally correct.
With a little practice in the dead-house, I think it is always
possible to make out the insertion of the urachus: and if we
cut in the middle line below this point, we cannot injure the
peritoneum. It must be remembered that in Thornhill's day
there was no anæsthesia.

Samuel Pye* of Bristol, in 1725, wrote a small pamphlet on

means of doing so in the very full records of the Bristol Royal Infirmary, which
are now in its Library. Thornhill was its first surgeon, appointed in 1737;
and he was the most conspicuous surgeon of his day in Bristol. He was
highly prosperous, somewhat of a dandy, almost independent of his profession;
a brilliant operator, but apparently careless of reputation, and following
independently the bent of a genius that was clearly somewhat erratic. It was
in complete harmony with his nature that he should not take the trouble to
say a word about his work, but leave the writing to his friend Middleton.

* Samuel Pye was a Bristol surgeon, who had a great reputation for the
treatment of venereal diseases.

> "The home-bred documents of Old Sam Pye
>   Were standing rules to treat their buboes by."—CHATTERTON.

He was a rival of Thornhill; and his pamphlet was clearly directed mainly
against Thornhill himself. He had very little experience of the operation
(four cases), and his objections to it were mostly fanciful and stupid. "Old Sam
Pye" had the somewhat dubious honour of being reviled by Chatterton in
an unpublished, and unpublishable, poem now in the library of the Bristol
Royal Infirmary.

the operation, which does little more than show his own failure
to grasp its principles or to put it properly into practice. Of his
four cases, it is noteworthy that in one he got primary union of
the wounds, and the boy, aged five, was playing in the street on
the fifteenth day. Macgill of Edinburgh wrote letters to Middle-
ton and to Cheselden, recording a few cases which were printed
in their books. In France, Morand performed the operation on
Roussetus's principles, and in 1728 wrote a treatise on " Cutting
by the High Apparatus," as it was sometimes called. Several
other surgeons performed the operation, and wrote about it at
this time; but no improvement, scarcely any change, in the
method was recorded till Frère Côme (or Cosme), a well-known
lithotomist in Paris, took it up. Côme's book was published in
1779, after he had finally elaborated his plan. He is said to
have operated on nearly a hundred patients, and with almost
uninterrupted success. The chief peculiarity in Côme's pro-
ceeding was the use of the *sondè a dard* introduced into the
bladder through an opening made in the perineum into the
membranous urethra. This instrument was a curved hollow
sound introduced through the perineal opening into the bladder;
by depressing it the point was made to raise the bladder into
the wound, and the concealed dart or stilet was made to
perforate the bladder. The aponeurosis between the recti was
divided by a curved knife with a button point, which pushed
the peritoneum in front of it. Deschamps suggested that the
low opening for the introduction of the sound should be made
through the rectum.

Le Blanc in 1773* is said to have recommended operation
à deux temps, a proposal which was revived by Vidal de Cassis
in 1832, and again quite recently by Neuber of Kiel, and also,
for cases with putrid urine, by Senn of Chicago. The
advantages of the operation in two stages are not so evident in
the case of the bladder as in similar ones on the intestinal tract.
On the other hand, Professor Rydygier of Krakow, ignoring the
supposed safety conferred by extra-peritoneal methods, and
depending on the known capability of the peritoneum for rapid

* Dulles, *Med. and Surg. Rep.*, Phila., June 30th, 1888.

union, has, quite recently, boldly opened the bladder through its peritoneal aspect and immediately sutured it. Not many surgeons have adopted this practice.

From its early introduction almost to the present day the operation steadily declined, both in favour and in mode of performance, and we need not follow its fortunes.* Its revival has been simply part of the general revival of surgery which has marked the last twenty years. At the present day the operation is where Douglas and Thornhill left it—improved in the same manner and by the same influences as other surgical operations have been improved, and not least in the way of discarding all ingenious contrivances for doing away with the necessity for educated fingers and anatomical knowledge.

In quite recent days its revival has really been part of the quiet resuscitation of many old and neglected operations. If anyone more than another deserves credit for its re-introduction, it is Sir Joseph Lister. But the most conspicuous stimulus has been derived from the experiments of Garson and Petersen on the influence of distension of the rectum in increasing the depth of the supra-pubic interval. The real value of this invention is now openly questioned by many surgeons, while there is no doubt as to its occasional risk: but however this may be, their experiments have called attention to the operation; and this attention has assisted in placing it permanently among recognised surgical proceedings.

INDICATIONS FOR OPERATION.

Broadly it may be said that supra-pubic operation may be called for in dealing with any conditions which may demand cystotomy. Removal of stones, foreign bodies, or tumours may be carried out best by the supra-pubic operation; drainage of an inflamed bladder; direct treatment of tuberculous disease of the bladder; retrograde catheterisation; the provision of an exit for urine in obstruction of the natural passages; the formation of an artificial opening in cases of malignant disease

* See Dulles, *Lancet*, Dec. 3rd, 1887.

where suffering is caused by obstruction from the clotting of blood, or from simple distension and contraction of the bladder muscle—may all be indications for operation. But they are indications only in competition with other proceedings; and the comparative values of these operations must be estimated.

Stone in the Bladder.—The best operation for stone in the bladder is on all hands admitted to be Bigelow's—lithotrity with evacuation at one sitting. As experience increases and instruments are improved, the range of Bigelow's operation is being extended. Stones of a very large size are crushed by powerful instruments and completely removed at one operation; while, with the help of very delicate instruments, stones are now successfully removed from very small children, almost from infants. The operation of election for stone in the bladder is undoubtedly Bigelow's : on this there is almost universal unanimity.

Under certain circumstances this operation is out of court. Thus, the stone may be so hard that no instrument will crush it, or the process of crushing may be attended with danger to the vesical walls from the flying off of sharp fragments; or it may demand such a prolonged operation that the patient's life is endangered. Again, the stone may be so large that crushing by any instrument introduced by the urethra is out of the question. Or, in young children, from smallness of the urethra, it may be impossible or dangerous to pass efficient instruments. Or, lastly. looking at the general condition of the patient and the size of the stone, it may appear that a quick cutting operation gives. the best chance of recovery. Then the decision is one between lateral, or at least perineal, lithotomy, and the operation over the pubes.

Taking the case of young children first, we often hear it said that for removal of stones in the bladder we do not want a better operation than lateral lithotomy. Recent work in crushing would seem to show that here we have already got an operation at least as good as, probably better than, lateral lithotomy; while, as regards remote results, there can be no comparison. A child who has been cut for stone is not safe from stricture of

the urethra as he grows up. In the face of actual facts, the position of ignorance as to bad subsequent results after perineal lithotomy cannot be upheld. In this Bristol district, where stone is rare, I have seen in the last nine years five operations for perineal fistula following perineal lithotomy, and I have been concerned in the treatment of one case of stricture and one of fistula from the same cause. And the treatment of these catastrophes is not always easy or successful ; the stricture, at least, may be said to last during the life of the patient. In a very successful operation for fistula after lithotomy performed by Mr. Board at the Bristol Infirmary, the stricture was not marked, and the result may be said to be curative; but in all the others which I have seen, the operation did not cure the stricture. Knowing what we do of the causation and results of traumatic stricture of the urethra, it is surprising that evil effects so seldom follow perineal lithotomy in children. Sexual incompetence, or rather sterility, must also be reckoned among the possible effects. . Haemstadt, according to MacCormac,[*] found that of eighteen married men who had had lithotomy performed in childhood, only one had children.

Stricture, fistula, sexual incompetence—separately or combined —must be admitted to be rare sequences of perineal lithotomy. But that they are possible sequences cannot be denied. Now if the supra-pubic operation can show immediate results as good as the perineal, and a complete absence of remote drawbacks, then the supra-pubic operation should be selected. Even if the · per-centage against the perineal were as small as one, this one case for fixing a rule in sound surgery should be decisive. In children, therefore, I should say that where the crushing operation is negatived, the supra-pubic should be adopted. A further argument in favour of its adoption in children is the favourable position of the bladder, and the usually healthy condition of the involved tissues.

In the case of adult males, the size of the stone and the condition and age of the patient have most influence. Prolonged anæsthesia for crushing and evacuation is full of danger for old

* *Lancet*, Mar. 19, 1887.

or enfeebled patients ; and stones over two ounces in weight are best removed by the supra-pubic route. Very large stones must be removed in this way. Indeed, the size of the stone would seem scarcely at all to influence the death-rate in this operation. The patient from whom Mr. T. Smith removed a stone weighing 24⅓ ounces made a better recovery than Sir Henry Thompson's patient, whose stone weighed 14½ ounces. Here the operation is one of necessity, not of choice. Such enormous stones can be removed neither by crushing, nor by cutting through the perineum.

For encysted stone the supra-pubic operation has been properly commended. In one such case on which I operated (for Dr. Rattray of Frome) the stone was found almost completely encapsuled at the top of the bladder, almost in the urachus ; and was removed without, properly speaking, entering the general cavity of the bladder. It lay immediately under the anterior wall of the bladder.

In elderly patients with stones which it is either impossible or unwise to crush, it is mainly a question of saving of life. In very young patients it is not so much a question of saving life— all the operations are comparatively safe in this respect—as of permitting an existence free from future trouble. Now, the drawbacks after perineal lithotomy, if small, are undoubtedly present : after supra-pubic lithotomy they are simply non-existent. It is probable that increasing perfection of instruments will admit of crushing in male children of the most tender age ; but a small proportion must always remain where a cutting operation is best. This operation, with the evidence before us, should nearly always be the supra-pubic one. For cases in advanced life, or with large stones, the operation should, in the majority of instances, be the supra-pubic one.

In the case of females with stone in the bladder, the question of supra-pubic cystotomy is not so frequently presented to us. The stone must be a very large one which cannot be crushed through the female urethra. For stones of moderate size which are too hard to crush, incision of the urethra, with dilatation of the neck of the bladder, and subsequent immediate suturing of the divided urethra, is, in my opinion, a simpler and better

operation than supra-pubic cystotomy.   Incision through the
bladder and vagina is not a commendable operation.   For very
large stones, four ounces and upwards, the supra-pubic operation
is probably the best.

Nothing need here be said as to the symptoms and diagnosis
of vesical calculus.

Foreign Bodies.—Here the operation selected must depend on
the nature of the foreign body present.   In most cases the call
to operate is not made till the body is coated more or less
completely with phosphates, and in many the body is completely
buried in the heart of a stone.   In the second case, if a cutting
operation is decided upon, it is lithotomy pure and simple; but
if lithotrity is the operation selected, and the foreign body is
metallic, then crushing may result in failure.   Of course, if it is
known that a foreign body is present that cannot be crushed,
this calamity may be avoided.

In those cases where attention is called to the presence of
the foreign body very soon after it has been introduced, and the
nature of it is known, attempts may be made to extract it by
means of any of the ingenious Redressors, or Basculeurs, or
Duplicators, or special forceps invented for the purpose.   The
success which has followed the use of these and such instruments
in removing foreign bodies from the bladder has been most
encouraging.   In Denucé's collection of 240 cases of foreign
bodies which had necessitated lithotomy or extraction, there
were, prior to 1830, 100 cases of lithotomy and 27 of extraction;
while, subsequently to 1830 there were only 21 lithotomies, the
rest being extractions.   Poulet found in a fuller analysis a
somewhat greater proportion of lithotomies.   He points out
that simple extraction is by no means so free from danger
as might be supposed; that the bladder or the passage may
readily be wounded; and that, on the whole, there is not much
to choose between cutting and extracting, at least so far as the
male bladder is concerned.   In the case of the female bladder,
if dilatation of the urethra is employed and the bladder
explored, extraction is a far safer proceeding.

Any attempt to give definite rules for the selection of the best mode of removing foreign bodies must fail in the face of their almost endless variety. Generally speaking, if the foreign body is very long, if it is composed of brittle material, such as a glass tube, and more especially if its ends are sharp, or perhaps embedded in the vesical walls, the supra-pubic operation is the best to select. In cases where there is evidence of perforation of the bladder, the supra-pubic operation must be extended to abdominal section in order that the rent may be sutured. Evidence of perforation of the bladder usually follows closely on the occurrence of the injury. In some cases, however, perforation takes place very slowly by ulceration, and reaches the general cavity only after the formation of peri-vesical abscess. In an extraordinary and probably unique case which I have recorded elsewhere,* one end of the rib of an umbrella, two inches in length, lay among the intestines, while the other extremity was inside the bladder embedded in a phosphatic stone of the size and shape of a plover's egg. The patient, a lunatic, had exhibited no symptoms of its presence, and died from another cause. Here coeliotomy would have been essential to the proper completion of the operation, for in no other way could the perforation have been closed.

There can be no doubt that the removal of a sharp or large foreign body may be carried out with less risk of wounding the vesical walls by the hypogastric than by the perineal method. There is more room ; the whole body is within easy reach of the finger, and perhaps may be brought into view; and it is easy to ascertain whether the bladder is wounded. The whole question is one which must be left to the discretion of the surgeon, acting upon such information as to the nature of the foreign body as he can gather. The operation selected should be one by which the foreign body can certainly be removed; it is little less than a catastrophe to have to resort to the supra-pubic route when the perineal fails. All such tentative surgery is to be sternly condemned. There is little to choose as regards actual mortality between the supra-pubic and the perineal operation; if there

* *Bristol Med.-Chir. Journ.*, March, 1886.

is the slightest doubt that one will fail, the other, which cannot fail, should unhesitatingly be adopted.

Tumours of the Bladder.—An accurate and exhaustive classification of tumours of the bladder has yet to be made. Sir Henry Thompson,* working upon such material as lay to his hand, has given a classification which is admittedly tentative and temporary. Looking at such growths in the broadest possible aspect, I think the best and simplest division is into polypus, papilloma, and cancer. For clinical purposes this division is certainly satisfactory; and it is not unlikely that, with minor subdivisions, it might be made to include all known varieties o bladder-growth.

Polypus is almost peculiar to the bladder of children. In structure it is practically identical with the simple mucous polypus found on the nasal and other mucous membranes. Some of them contain much mucoid substance, being practically myxomata; while others are more dense, containing varying quantities of fibrous tissue. These polypi are often found in great numbers, sometimes filling and even distending the bladder.

Papilloma, also termed "Villous Tumour," is the best known of bladder-growths. It is by no means uniform in appearance. In some it is represented by an exceedingly fine, almost impalpable, growth of fimbriæ or papillæ, set upon a narrow pedicle and spreading out into a more or less distinct mass, not unlike a cauliflower in shape. Sometimes these fine growths are single, oftener they are multiple, being three or more in number; rarely they are found scattered over the whole of the cavity. Each papilla or villus consists of a fine basemen. membrane containing blood-vessels, covered by several layers of columnar cells identical with those covering the mucous membrane of the bladder. The villi are about the same thickness from base to apex; the apex of the whole growth is broader than the base, on account of their dividing as they grow. The vascular walls are very thin and easily ruptured.

* *Tumours of the Bladder*, London, 1884.

Thompson calls this variety the Fimbriated Papilloma. A second variety, in which the fibrous tissue at the base of the growth (which, by the way, usually contains inorganic fibre) is in considerable amount, forming a conspicuous part of the tumour, he calls Fibro-papilloma. Some tumours described as myoma would probably belong to this category. Here the fine fimbriæ, though present, are not usually so long or so perfectly developed as in the previous variety. In a third variety the fibrous material at the base is still further developed, and exhibits in its meshes material suggestive of malignancy. It is doubtful, however, whether real malignancy could be proved, in these cases, by any test other than tendency to recur, which of course may also be described as continued growth after incomplete removal.

All forms of malignant disease have been found invading the bladder. Sarcoma is rare, although not so rare as is generally supposed (Southam); encephaloid has been met with; scirrhus of the bladder proper has been described, but is usually an extension from a primary invasion of the prostate; epithelioma is probably the most common form of malignant disease met with.

Dermoid tumour has been found in the bladder, as in most other structures; and one case is recorded in which Bryant successfully removed such a growth from the female bladder.

The symptoms of polypus in the bladder in children have usually been those of stone, with more than the ordinary amount of pain, and with, perhaps, more frequent attacks of tenesmus.

The symptoms of papilloma are very well known, and usually sufficiently definite to make a diagnosis highly probable. Still, exceptions exist where diagnosis is rendered certain only during operation. Symptoms impress men differently. I have removed a papillomatous growth from the bladder of a lady who was for three years treated by distinguished men for " gouty kidney." A colleague who diagnosed the case, and sent me the patient, concluded it was papilloma after a few minutes' conversation

with the patient. Much, therefore, depends on the point of view from which one looks at symptoms.

The first, the last, and usually, but not always, the only continuous symptom of papilloma is hæmaturia. In some cases it is positively the only symptom, the patient showing no signs of bladder irritation or inflammation or other trouble beyond bleeding, and dying in the end simply from loss of blood. In most cases, however, there is increased frequency of micturition; occasionally there is tenesmus; and in some cases, where the blood coagulates in the bladder, there is complete retention, with constant and ineffectual attempts to empty the bladder. In one case I had to scoop out with the fingers enormous quantities of clot, which distended the bladder, before I could reach the tumour. The hæmorrhage is least profuse in the early stages and increases in amount, not steadily but with remissions, as the disease advances.

In the earlier stages the hæmorrhage sometimes makes its appearance in a manner which is highly characteristic. The water first passed is clear, or but slightly tinged with blood; towards the end of micturition the tint becomes a brighter red, and as the act ceases, a few drops or a little stream of pure blood comes away, with some pain and straining. This appearance is no doubt produced by compression of the tumour by the contracting bladder and rupture of some of its thin-walled vessels. As the bladder refills, the villi, soaking in the urine, go on bleeding, and cause a general admixture of blood, or the formation of small or large coagula according to the amount of blood discharged.

Passing the sound in cases of papilloma usually gives negative results. The finger in the rectum if the patient is a male, in the vagina if a female, follows the sound as it is moved about, and, through the mucous membranes, estimates the even thickness of the bladder-walls, and notes any fulness or induration between it and the metal. Only large and firm papillomata can be detected in this way.

It is important to make frequent and careful microscopical examinations of the urine, with a view to the discovery of portions

of the fimbriæ which are constantly being shed. The sediment from one to two days' urine is permitted to settle, washed to get rid of the blood, and examined in detail. Sir Henry Thompson makes the useful suggestions, that the bladder should be washed out freely with warm water, or that a lithotrity evacuator should be used to obtain portions of the growth for examination. The finding of fimbriæ in the urine is pathognomonic. The use of the lithotrite to grasp and remove portions of the growth is a somewhat haphazard proceeding.

In the case of epithelioma of the bladder, signs of vesical irritation come on early and are more urgent than in papilloma. Bleeding is more variable as regards both occurrence and amount. Pus is found is considerable quantities in the urine, and if there is much irritation, ropy mucus as well. Pain is a fairly constant and often urgent symptom, referred frequently to the hypogastrium, and often to outlying regions, as the point of the penis and down the nerves of the thigh. A tumour or thickening may sometimes be palpated between the sound in the bladder and the finger in the rectum or vagina. Fragments of the growth discovered in the urine, or in water after washing out the bladder, may confirm the diagnosis. As to the means of diagnosing other forms of malignant growth, there is little beyond general principles to guide us.

It would seem that we are now in the way of obtaining, if we have not already obtained, a really useful method of exploring the cavity of the bladder by means of the electric light. According to Hurry Fenwick,[*] the incandescent lamp cystoscope of Nitze or Leiter is an instrument of real practical utility, by means of which the whole cavity may be visually inspected. I have not much personal experience of the instrument; a full description of it and the manner of using it is given by Fenwick in his work and in the papers referred to. Some practice with the instrument on the dead subject and on artificial bladders is advisable before employing it in the living.

As to the occurrence of these growths: polypus is apparently

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[*] *Electric Endoscopy*, Lond., 1888, and *Brit. Med. Journ.*, Feb. 4th, 1888, and May 4th, 1889.

almost confined to young children; papilloma is found most frequently in adult males; epithelioma, while equally frequent in both sexes, is probably most common in late life. No part of the bladder has immunity from these growths; all of them are most frequently found in the base and fundus, and this holds true more especially of epithelioma.

In every case where polypus or papilloma of the bladder is diagnosed, operation (with the ordinary exceptions) is indicated. In the case of males, I consider that the operation selected should be supra-pubic cystotomy. In the case of females, removal should be attempted through the urethra, except in the case of very large or very numerous growths spread over the general surface of the mucous membrane. Setting the question of operation on the female aside for the moment, we may now discuss shortly the reasons for selecting the supra-pubic operation in the male.

The problem is a double one : firstly, by what route may tumours of the bladder most easily be reached; and, secondly, by what route can they most readily and uniformly be removed ?

In answer to the first question, the present position of the surgical mind is probably not in harmony with the most recent surgical writings. Thus, in 1884, Sir Henry Thompson* declared emphatically in favour of the median perineal route. The finger, carried through the perineal opening, is, he says, practically always capable of exploring the whole cavity, particularly with the help of " a strong and determined assistant " to push the contents of the pelvis downwards. That the whole bladder may be explored with the finger-tip in this way, there can be no dispute; but in the case of fat patients with powerful abdominal muscles, the proceeding must be more one of muscular strength than of delicate palpation. But that it can be compared with the supra-pubic method as regards ease or thoroughness, no one who has tried the two plans will admit. Every part of the bladder, after the " Sectio alta," can be explored with the greatest ease by the finger, and much of its surface can be brought within the range of vision. No force

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· * *Tumours of the Bladder*, p. 11.

is required to push up perineum, or press down parietes; the bladder lies ready and open to the finger.

And in all seriousness it may be asked, What is the use of exploring the bladder at all, except to proceed to removal of the tumour? I have already in this work protested against the too prevalent fashion of "exploratory operations": an exploratory operation on the bladder that cannot at once be converted into the best curative operation should be condemned off-hand. Exploration and removal should go together.

As to facility of removal, there can be no doubt that for the great majority of tumours the supra-pubic operation is better than the perineal. A few tumours could be removed only in this way; and as it is rarely possible exactly to locate a tumour before operation, we should select the mode of operation which will always succeed. Some operations begun as perineal have had to be concluded as supra-pubic: this ought never to occur. Although there is probably little to choose as regards immediate mortality between the high and the low operation, there can be no doubt that a combination of the two is infinitely worse than either separately. If, in every case where a tumour can be removed by the low operation, it can also be removed by the high; if, in some cases (not diagnosable beforehand), the tumour could be perfectly removed only by the high route; and if, in every case, manipulation is easier and more precise, the decision in favour of supra-pubic cystotomy for removal of tumours in the male bladder cannot be in doubt.

In the case of the female, I think the best routine method is to proceed by incision of the outer urethra, followed by suture after operation, with dilatation of the neck of the bladder. It is surprising how this division of the outer urethra, liberating the finger from constriction and setting free an invaluable inch or so of its length, facilitates exploration of the vesical cavity. The operation is a trifling one as compared with the low operation in the male, the bladder is rendered more accessible, and in a far less proportion of cases will there be failure to remove the growth. Still, the high operation in women may be called for in certain rare cases of mal-posed and large-sized growths.

For *prostatectomy* or removal of hypertrophied lobes of the prostate gland causing obstruction to the flow of urine, supra-pubic cystotomy may be performed. This operation, although according to Mansell Moullin * it had been performed several times previously, was practically introduced by the late Mr. McGill of Leeds in 1888. Since then it has been performed over a hundred times with a fair amount of success, and may now, for certain conditions associated with enlargement of the prostate, be reckoned amongst beneficent operations. The discussion of these conditions would lead far beyond the limits set to this work. Broadly speaking, physical obstruction from enlargement of the prostate in a fairly healthy fat man who has no renal disease, whose bladder has some contractile power, but leaves a large amount of residual urine, and in the treatment of which the employment of the catheter is difficult or unsatisfactory or impossible, may properly be treated by supra-pubic prostatectomy. Putrid urine is a contra-indication: recurring attacks of cystitis would rather be considered an indication.

The operation has rather a high mortality, 94 operations collected by Moullin having been followed by a direct mortality of 20 per cent. The death-rate is improving, however: while the first half showed a 25 per cent. mortality, the second half of the cases had only a 15 per cent. mortality. Mayo Robson † in 12 operations lost only one case from the immediate effects of the operation, and one in a few weeks from senile decay. Bryson ‡ in 27 cases of operation had a death-rate of 25 per cent.; in 13 radical cure followed. Eugene Fuller of New York, using perineal incision for dependent drainage, had six cases, all successful.

As regards the after results, it is not possible to give definite information. In an exhaustive paper by Belfield § 88 operations are reported as being followed by 12 deaths. Of the cases of recovery 22 are said to have been successful as to the restoration

* *Enlargement of the Prostate,* London, 1894, p. 142.
† *Brit. Med. Journ.,* July 14, 1894.　　‡ *Phila. Mea. News,* June 29, 1895.
§ *Amer. Journ. Med. Sc.,* Nov., 1890.

of the function of voluntary urination and 11 to have been failures, while in two the success was incomplete. Moullin gives the per-centage of failures to recover power of micturition at about 20.

A 20 per cent. mortality and a 20 per cent. proportion of failures to cure in cases that recover from the operation would probably fairly represent the therapeutic value of the operation of supra-pubic prostatectomy. It need scarcely be said that, with this record, the operation should be undertaken only in carefully selected cases.

Other conditions for which supra-pubic cystotomy, as an exceptional operation, may be performed are : (1) as a means of drainage in chronic and intractable cystitis; (2) in cases of blood-clot in the bladder, from renal or other source, causing obstruction to the flow of urine; (3) in tubercular or other ulcerative conditions of the bladder-wall for direct treatment and drainage ; (4) for retrograde catheterisation, and (5) by Thomson of Dublin as a means of cure in otherwise incurable perineal fistula. I have once with good result performed the operation to relieve pain in a case of cancer of the bladder, and once, also with good result, for complete paralysis of the bladder, in which repeated attacks of cystitis endangered life. Of these rarer indications, that for tuberculosis of the bladder seems to be the most useful. I have operated twice for this condition, not with much success as regards permanence of result, but certainly to the relief of pain and improvement of the disease. Dr. James Bell * strongly urges the value of the operation for this condition, and has got good results from it.

ANATOMICAL CONSIDERATIONS.

The part of the bladder concerned in this operation is that portion which lies behind the pubes, between the neck and the insertion of the urachus. Between the anterior wall of the bladder behind, and the posterior surface of the pubic bones and

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* *Amer. Journ. Cutan. and Gen.-Urin. Dis.*, Aug., 1892.

the abdominal muscles in front, is a pyramidal-shaped space filled with connective tissue and blood-vessels : in and around this space take place the surgical manipulations in this operation. This space varies in size and shape, not only anatomically in different individuals and at different ages, but also according to the condition of the bladder as to emptiness or distension.

The posterior wall of the sheath of the rectus definitely ends at the curved margin of the semi-lunar fold of Douglas, between the umbilicus and the pubes ; from this margin arise two layers of fascia, which pass downwards between the rectus and the peritoneum. The anterior layer is continued as a thin covering to the rectus and pyramidalis, and lines the space between the bladder and symphysis pubis (Braune) ; the posterior lamina passes across behind the urachus on to the bladder, in order to invest it, and to join the prostatic capsule and pelvic fascia. Into the potential space between these two laminæ the expanding bladder arises : they may, in fact, be regarded as the fascial boundaries of the area of operation. On the posterior lamina lies the peritoneum, following it in all its movements.

The parietal peritoneum is reflected on to the bladder at its summit, at a point which, in the middle line, always corresponds to the insertion of the urachus. Behind this point the peritoneum is firmly attached to the bladder-wall ; in front of it, the peritoneum can scarcely be said to be attached to the bladder at all, though, when the bladder is empty, it lies closely apposed to its anterior surface as low down almost as the neck of the organ. The level at which the peritoneum is reflected from the parietes on to the bladder may be, as regards the bladder itself, at any point between the neck and the fundus, as high up as its summit represented by the insertion of the urachus. As regards the parietes, the level of peritoneal reflexion is more variable, but may extend to any distance between zero and three inches above the pubes.

Distension of the bladder is the palpable means of elevating this peritoneal fold ; and as, almost from the earliest conception of the operation, the danger of wounding the peritoneum, and this means of avoiding it, were fully recognised, it might be

supposed that the anatomical descriptions would, by this time, have been exhaustive. They are certainly abundant, but they are by no means harmonious.

One of the earliest proved points was, the difference in the shape and position of the child's bladder as compared with that of the adult. In 1756, Heuermann of Copenhagen* pointed out that the child's bladder was more elongated than the adult's; that it was practically an abdominal and not a pelvic organ; and that the peritoneal reflexion from it when the bladder was full rose higher than, and when empty did not descend so low as, in the adult.

Cruveilhier, Malgaigne, Richet, Paulet, Sappey, and others made observations on the anatomy of the bladder in confirmation and extension of the views of Heuermann. More recently Langer,† Chauvel, ‡ Mannheim, § and others have devoted special attention to the subject.

The topographical anatomy of the bladder in general, and more particularly in adults, has in the last twenty years received important additions from the study of frozen sections. Those of Pirogoff and Braune are among the best known; and among their followers, special mention must be made of Garson, who devoted particular attention to the bladder during emptiness and distension, and also when displaced by an air-bag distended in the rectum. Garson's sections were made in Vienna in 1877, and his paper was read by Braune at the Congress of German Surgeons in 1878.‖ Petersen of Kiel heard Garson's paper, and used on the living body the rectal bag as Garson had used it on the dead.¶ The practice of rectal distension seems to have rivetted the attention of surgeons; and the general revival of the operation may be said to date from the reading of Garson's paper in 1878, or more correctly perhaps from the publication of Petersen's paper in 1880.

* See Gross of Nancy, *Mem. Congres Francais de Chir.*, 1887, 2me Sess. 1886.
　† *Zeit. der Gessellsch, der Aertzte in Wein*, 1882.
　‡ Art. "Cystotomie," *Dict. Encyc. des Sc. Med.*, xxv., p. 106.
　§ *Ueber den Hohensteinschnitt bei Kinderen*, Berlin, 1884.
　‖ *Archiv. f. Anat.*, 1878, and *Edin. Med. Journ.*, Oct., 1878.
　¶ *Archiv. f. Klin. Chir.*, 1880, xxv.

In respect of all these studies in children and in adults, I am bound to say that a perusal of most of them does little more than convince one that the topography of the bladder is surely the most variable in all human anatomy. It would be both tedious and unprofitable to recapitulate all the measurements which have been given; I shall therefore shortly summarise the average results.

In children up to eight years of age the peritoneal fold, when the bladder is empty, never descends below the upper margin of the pubes, and often rises a few lines higher; with a distended bladder the fold will rise, according to the degree of distension, from one to two and a half inches above the pubes. Now, as a supra-pubic space uncovered by peritoneum of two inches in length can never be necessary in the performance of the supra-pubic operation in children, and a space of an inch or an inch and a half is quite sufficient for all practical purposes, it is clear that, in children at least, there is no difficulty whatever, with moderate distension of the bladder, in avoiding the peritoneum. In the 300 operations on young children collected by Gross of Nancy, there were only nine cases of wound of the peritoneum, and only four deaths in consequence. When we recollect that most of these operations were performed in the last century, we must admit that the risk of wounding the peritoneum, in children at least, is very small. As a matter of fact, a surgeon with some experience in abdominal work would treat very lightly the risk of wounding the peritoneum in children; indeed, the operation would seem to be equally easy in these, whether the bladder is distended or not.

As regards adults, these statements must be modified a little. The neck of the bladder, the internal orifice of the urethra, in male adults lies about two inches below the upper margin of the pubes. Now, the peritoneum between the pubes and the bladder cannot descend lower than the external longitudinal muscular layer of the bladder, which is inserted into the lower border of the pubes. This distance is nearly always under an inch in length. Indeed, in most the reflexion of peritoneum in a perfectly empty bladder takes place very near

to the upper margin of the pubic bones. In old men it is lowest, and in these sometimes the whole upper surface of the bladder appears cupped and concave, without the appearance of any peritoneal folding at all. With Barwell,* I cannot believe it other than impossible that the peritoneal fold could lie as low as two and a quarter inches below the upper margin of the os pubis.

This refers to the lower limit of the peritoneal fold in the contracted state of the bladder; we must now turn to the effects of distension of the bladder alone, and of this combined with inflation of a bag in the rectum. Of the influence of distension of the bladder in raising the fold there is no doubt whatever. With different degrees of distension, that is to say, after injection of varying amounts of fluid up to 21 ounces, we get an elevation from zero up to nearly $2\frac{1}{2}$ inches. But there is no constancy. Thus, two males of 34 and 35 respectively after an injection of 10 ounces into the bladder give elevations of $\frac{3}{4}$ inch and $1\frac{3}{4}$ inches respectively. One male of 30 with 15 ounces in the bladder gives an elevation of $1\frac{15}{16}$ inches; while another, aged 35, with 16 ounces gives an elevation of $2\frac{3}{8}$ inches. Petersen's table I confess I cannot understand. Thus, with 21 ounces of fluid in the bladder, one patient has the suprapubic fold one finger's breadth *below* the pubic margin, while another has it $1\frac{1}{2}$ inches above. There is no use in striking an average between extremes such as these, when we are told nothing about the anatomical conditions. In fact, according to Petersen, the chances are about even that a pint of fluid in the bladder will not raise the peritoneal fold at all. (In ten cases the elevations in inches are: .33, 1.49, 0, 0, .669, .29,—.66, .39, 0, .6.) Until these observations are confirmed by others I cannot accept the validity of Petersen's results, more especially as they contradict the clinical and operative experience of many years and many men.

A. B. Strong† of Chicago has made special experiments on this point with the same object as those by Petersen, Garson, and Fehleison. A study of Strong's results serves to further confirm the validity of my arguments.

* *Med.-Chir. Trans.*, 1886, p. 354.   † *Annals of Surgery*, Jan., 1887.

One criticism must be made on Strong's paper. In Plate I. of it, he places the peritoneal reflexion at the level of the middle of the symphysis, a position described in the text as " one and a half inches below the crest of the symphysis pubis." In Plate II. the peritoneal reflexion is at the junction of the upper and middle thirds of the section through the symphysis, and this position is described in the text as " one inch below the crest of the symphysis pubis." These statements are in harmony with other measurements given in the paper. Now these measurements are either erroneous, or the depth of the symphysis must be estimated at *three inches*—an estimate which is manifestly excessive.

Strong's experiments clearly showed that " distension of the rectum alone elevates the base of the empty bladder, but does not raise materially the vesico-abdominal fold of peritoneum." A bladder distended with fluid tended to fall backwards into the pelvis; and he found that distension with air had a more potent influence in elevating the peritoneal fold. This is an observation full of significance. I suspect its true interpretation is to be found in the absence of all muscular influence in post-mortem experiments. It is scarcely credible that, in the living subject with normal abdominal pressure and contracting vesical and parietal muscle, the mere presence of gas, as compared with an equal amount of fluid in the bladder, should influence an anatomical displacement. It is surely more likely that the difference of conditions in the living and the dead must explain this difference. Strong considers that the operation is simplified by crowding the bladder against the abdominal wall by means of distension of the rectum, and considers that from 10 to 12 ounces in the rectal bag, and 8 to 10 in the bladder, are the best quantities of fluid to use. In his cases an average of 14 ounces in the rectum and 12 in the bladder elevated the peritoneal fold an average of 1½ inches above the crest of the pubes. Comparing Helmuth's experiments with Strong's, we may note that in 25 cases, with an average quantity of water in the bladder of 27 ounces and no rectal distension, the fold was raised 2 inches.

One observation of Strong's I must heartily endorse, and that

is the wisdom of using thin rubber for the rectal bag. A thin bag follows up the gut in its windings; it tends to straighten it between the anus and the sacral promontory; and, he might have added, it cannot burst the bowel, while it utilises to the full any special distensibility which the rectum may possess.

A careful study of these post-mortem experiments almost forces one to the conclusion that they are not to be entirely trusted as guides in performing the operation on the living subject, and that we must ultimately depend on the carefully recorded experience of practical surgeons.

I think it will be within the truth if we assume that, in an adult male, an injection of from 15 to 20 ounces of fluid will elevate the peritoneal fold at least one inch above the upper pubic margin, probably nearly two inches, and possibly over two inches.

The influence of distension of the rectum in adding to the elevation of peritoneum caused by distension of the bladder has been, in my opinion, much exaggerated.

FIG. 207. (C. LANGER.)

Sagittal Median Section through the Pelvis of a Young Man, the Bladder being Contracted.

Petersen's table I cannot believe to be trustworthy, for reasons already stated; but even giving him the status of a

special pleader in favour of distension of the rectum, we find that the average increase of elevation is a fraction of an inch. Supposing 14 ounces are in the bladder, and 21 ounces are injected into the rectal bag, we find elevations given of 1, 1.4, .23, .23, .83, .59, .29, .57, .24, .7 inches. Garson's table is even less satisfactory; Barwell's table shows that the elevation is very slight, and not such " as would be of any value to the operator." Theoretically, I have failed to understand why distension of the rectum should cause much elevation of the peritoneal fold. A bladder distended by fluid-pressure from the inside naturally assumes the globular shape; and this globular shape necessitates, for anatomical reasons, elevation of the peritoneal fold.

FIG. 208.   (C. LANGER.)

Sagittal Median Section through the Pelvis of a Young Man, the Bladder being Distended.

Supposing this globe is compressed between the rectal bag behind and the parietes in front, the first thing that happens is that it is flattened against the parietes; and this flattening can take place just as easily *over* the folded peritoneum as by burrowing *under* it. There is no physical necessity why flattening of the bladder should elevate the peritoneal fold; only general increase of its dimensions will do this. And practically, my

own experience, as well as that of a few others, is, that if rectal distension does elevate the peritoneum, it is to an unimportant extent. One thing rectal distension will do, and that is, to push forwards the posterior wall of the bladder : in the removal of tumours this displacement is of great value. It may also aid the operation by causing the full bladder to rise well forward under the parietal opening. For the purpose of elevating the peritoneum I am convinced that it is of little value.

A comparison of the accompanying engravings will bear out my argument. Figs. 207 and 208, from drawings of frozen sections, by Langer, show the relations of the bladder to the parietes when the organ is contracted and when it is distended. Fig. 209 is reduced by photography from a plate of
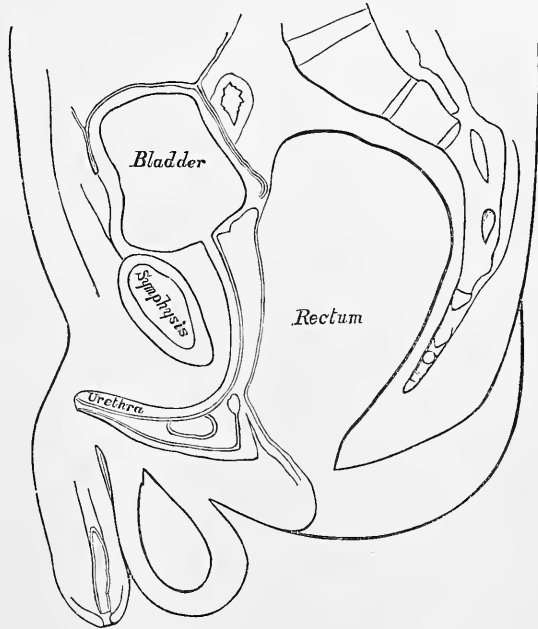
FIG. 209. (GARSON.)

Sagittal Median Section of Male Pelvis, with Distension of Bladder and Rectum.

Garson's to the same scale as Langer's, and shows the effects of combined rectal and vesical distension. It will be seen that the supra - pubic interval is practically as large after simple vesical distension as after combined rectal and vesical distension. On the other hand, the base of the bladder is pushed forward by the rectal bag, and the neck of the bladder is greatly elevated

from its natural position under the symphysis. Flattening of the bladder over the folded peritoneum without elevation of that membrane is also well shown in Fig. 209.

The structure of the bladder-wall is well known, and need not be dwelt upon. In operating, it must not be forgotten that the fibres of the external muscular coat arise in front from the posterior surface of the body of the pubes, and may easily be torn from their insertion by rough manipulation. Two large veins, continuations of the dorsal veins of the penis, pass through this insertion, one at each side of the symphysis, about three-quarters of an inch apart; if the knife is not kept carefully in the middle line, one of these may be wounded. The three muscular layers — external longitudinal, middle circular, and internal longitudinal—form the bulk of the bladder-wall. The submucosa is intimately united to the mucous coat; the mucous coat is, by comparison with that of the intestines, thin and anæmic. In some cases of old-standing calculus, however, it becomes greatly thickened, with the submucosa.

MORTALITY AND APPRECIATION.

The early mortality of the operation in the hands of those who studied its methods was under 15 per cent. for all cases, and some of these cases were very bad indeed. Dulles,[*] up to 1875, had collected records of 478 cases. An analysis of these cases showed that the results of supra-pubic lithotomy were as good as the lateral operation for calculi weighing between one and two ounces, and better for calculi weighing above two ounces. In 1881 his collection of cases amounted to 636, and the results continued unchanged. Dennis's collection of 127 cases operated on since 1879 gives a mortality of 9 per cent. It must not be forgotten that these cases include the very worst examples of stone. Dr. Ussendelft of Nijni-Novgorod[†] who, since 1883, has performed exclusively the high operation, has had 102 operations with two deaths, one being left with fistula

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[*] *Amer. Journ. Med. Sc.*, July, 1875.

[†] Abstract from *Vratch*, St. Petersburg, in *Annals of Surgery*, May, 1889.

and one with pyelitis. He had no fewer than 20 cases of primary healing.

At the present day the operation is chiefly confined to cases of very large stones, and to young children. To strike an average between these classes of cases, and draw conclusions therefrom as to the general mortality of the operation, is absurd. For children the cases are as yet too few to be entered in competition with other operations. Most surgeons who have had experience of the operation prefer it to all others, and many regard it as the only cutting operation which should be performed on the bladder. The operation is at present on the crest of a wave of popularity, and is perhaps just a little over-praised. Some maintain that it is much easier to perform than perineal cystotomy: this is a matter of opinion and of experience; it is certainly not, as compared with many other operations, difficult. Special consideration as to its value in saving life, and not interfering with subsequent comfort, has been given under "Indications for Operation," and need not here be repeated. The whole question may be summed up in the conclusion formulated by Dulles, whose words must carry great weight : " I have come to the conclusion that a temperate view of the subject will lead to the conviction that the suprapubic operation deserves to rank above all other methods of lithotomy for stones of large size, and that its applicability to any case should be carefully discussed before deciding to cut through the perineum."

THE OPERATION.

Preparatory.—The patient's bowels must be well opened, and the rectum cleared by enema immediately before operation. Pubic hair must be shaved off, and the skin in the neighbourhood thoroughly purified. The patient is laid on an operating table in the supine position, and the operator and his assistant stand on the right and left of the patient, as in an ordinary abdominal operation. Some surgeons recommend the Trendelenburg posture, particularly in prostatectomy. It is said, by causing the bowels to gravitate away from the bladder, to

provide more space for operating than the supine posture. Personally I prefer the supine posture.

The coverings of the patient should be so arranged that the thighs may be separated and access given to the rectum without uncovering any part of the body.   A blanket rolled round each limb, and a third over the chest and abdomen, will be found efficient.   A small table for setting irrigating reservoirs upon should be placed near the foot of the operating table.   A box, or small chair, or other simple piece of furniture placed on this table, will serve to place the reservoirs upon when it is desired to raise them three or four feet above the level of the patient.

Instruments.—The instruments requisite are few and simple. A sharp scalpel, a pair of scissors, a sharp-pointed tenaculum, and half a dozen pairs of catch-forceps, with the apparatus for distending bladder and rectum (if necessary), will suffice for the performance of most operations.   For the extraction of calculi, lithotomy forceps and scoops ; and for the removal of tumours, curettes, or scrapers, or bent forceps, will complete the list. Some surgeons recommend the use of special instruments : Sir H. Thompson, for instance, uses an "ivory separator" and a director, and for special conditions a hollow sound with a bulbous stilet ; but none of these instruments are essential.

Distension of the Bladder.—This, with most surgeons, is usually the first step of the operation.   Personally I now always make the parietal incision first, and carry out distension while the finger in the prevesical space is teasing open the fat and pushing upwards the peritoneum.   If the rectal bag is to be used, it may be inserted as the first part of the operation; but I think it should not be filled till the parietes are divided.   It is an advantage to make the dissection with the fascia and cellular tissue as lax as possible ; the rectal bag crowds forward the neck of the bladder and compresses the tissue against the abdominal wall, so that vessels are not easily seen and layers are not easily recognised.   The employment of the rectal bag for cases of calculus is of doubtful utility.   For bringing up the

posterior wall in the removal of tumours, the rectal bag is valuable. But it cannot do this efficiently till the bladder is opened, at least not while there is vesical distension.

Distension by hydrostatic pressure is, in my opinion, far superior to distension by hand pressure; and for these reasons:

(1) We know exactly what amount of pressure we are putting on the vesical walls. An elevation of three feet above the bladder is about one-twelfth of an atmosphere, or a little over a pound to the square inch; of two feet, one-eighteenth of an atmosphere, or about twelve ounces; and so on. Now, the amount of fluid injected is, for a diseased bladder, absolutely no criterion of safety. In many cases of large stone the bladder is enormously thickened at some parts, and almost ulcerated through at others, while it is frequently tightly closed around the stone. To force eight or ten, or even fourteen, ounces, as is often recommended, into such a bladder, is full of risk, and should never be done. In a case such as this, an elevation of two feet above the bladder would be safe; if this amount of pressure will not distend it, then it should be left undistended.

(2) The distending force is applied with perfect continuity, and with any degree of rapidity required. Hand pressure is bound to be irregular and intermittent; and if the injection is made as a part of and during the operation, it will almost certainly be given too rapidly. If the reservoir is placed at a height of two or three feet above the bladder before the surgeon begins to make the first incision, a gentle, steady, distending force, not unlike that naturally produced through the ureters, but more rapid, will be gradually filling the bladder.

(3) The pressure can be removed instantaneously simply by lowering the reservoir to the level of the bladder, and increased to any extent simply by elevating it. There is no time wasted in adjusting or removing the syringe. The apparatus is always ready; and by the simple proceeding of elevating or depressing the reservoir, without attaching or detaching apparatus, we can either empty the bladder or fill it to distension.

The way in which I now carry out distension of the bladder is as follows: a soft rubber catheter, English make, of size as

large as the urethra will admit, is passed into the bladder, and any urine present is withdrawn. The tube of the irrigator is then placed over the end of the catheter, and after a few ounces of boro-glyceride solution have trickled in it is removed, and the fluid permitted to run into a receiver. If the urine is very foul, this may be done again once or twice. The reservoir connected with the catheter is then placed permanently on its stand, three feet or so above the level of the patient, and left there gradually to distend the bladder while the cutting operation is going on. An elevation of three feet will be found enough for children; for adults with thicker and less distensile bladder-walls, four feet will be the upward limit of safety.

Any form of reservoir or fountain syringe that will stand is suitable. It is convenient to have it fitted with a glass tube as a gauge outside, marked in ounces, to indicate the amount of fluid that has escaped into the bladder. It ought to contain, at least, two quarts, in order that it may be used for washing out the bladder after operation.

The bladder is kept distended by the elevated column of fluid. The catheter is not removed; if of full size, no fluid will escape by its side. The somewhat barbarous proceeding of tying the penis with an elastic cord, so as to prevent escape of the fluid, is thus done away with. Should the patient strain much, and the abdominal pressure be increased, the fluid is squeezed out of the bladder into the reservoir; it is better that this should take place than that the bladder should be over-strained, or even ruptured. When the straining ceases, the fluid will pass in again.

The rubber tubing which joins the reservoir to the catheter should be at least six feet in length, and should be fitted with a stop cock, or similar contrivance, to check the flow when this is necessary, as, for instance, when the bladder is opened.

The lotion employed should be of the warmth of the body. No antiseptic for employment in the bladder is superior to boro-glyceride; and it may be used of considerable strength. A full tablespoonful of boro-glyceride to the quart of water is by no means too strong. The soft catheter attached to the irrigator

need not be removed during the whole operation. It can scarcely be in the way, and it is useful for conducting fluid into the bladder for a final washing out, and also for testing the security of the bladder-suture should this be inserted. Finally, if it is considered advisable to keep the bladder empty for some time, the catheter need not be removed at all, but may be tied in.

Nothing is said as to the amount of water to be injected. The capacity of the bladder is not to be measured by amount of fluid, but by its distensibility within limits of safety. Five or six ounces of injection might be dangerous in a bladder greatly contracted, and perhaps ulcerated, as in cases of large calculus; while a full pint might easily be borne in such a case as one of simple papilloma. The only safe criterion of measurement is that of force of distension; and this, I maintain, cannot be estimated accurately by the hand, but it can undoubtedly be measured by the means described. The finger on the bladder-wall warns us when distension begins to get excessive.

Distension by air instead of by water has been advocated by Bristow* on the grounds, that being light it does not depress the bladder but tends to raise it; that being compressible it does not cause so much risk of rupture; and that the operation is done with a dry wound. I have tried distension by air on one occasion and found the operation very much the same as in distension with water, except that when the bladder was opened the walls collapsed much more quickly than when water was used. This is certainly a disadvantage.

Distension of the Rectum.—The ordinary rectal bag, as supplied "by the trade," is a formidable-looking affair. It is strong enough to cause rupture of the walls of the rectum (as indeed has been proved too often), and when rolled up to its smallest dimensions it is larger than the largest rectal bougie. Rectal bags are now made in which the danger of over-distension is avoided by the use of silk webbing incorporated with the rubber. But the avoidance of this risk may be attended with

* *Annals of Surg.,* June, 1893.

a disadvantage, in not having the rectum distended to its full capacity. The distensibility of the rectum varies greatly in individuals: the protected rubber bag, while safe for a small rectum, does not utilise to the full the distensibility of a large one. I should discard the rectal bag in common use absolutely, and use instead a more delicate apparatus. A child's air-balloon or a delicate soft rubber urinal, fitted on to a celluloid catheter, answers the purpose admirably. While strong enough for the purpose intended, it is not strong enough to rupture the gut. It must be remembered that the chief virtue of the rectal bag is, not to increase the supra-pubic interval, but to bring the posterior wall of the bladder up into the wound. As usually employed the rectal bag and bladder are little else than two fluid globes mutually undergoing a compressing and flattening process between the parietes and the sacrum. The rectal bag can scarcely bring the bladder-wall forwards till the bladder is opened; then it does so with ease and without the obstacle of a globe of fluid under high pressure. For this purpose the air-balloon is quite strong enough; and its use is attended with no danger, for it will give way (as I have ascertained) before the rectum will.

Fig. 210.

Rubber Bag for Distension of the Rectum.

The balloon, fitted to the catheter, is greased (oil injures the rubber tissue) and introduced well into the rectum. The end of the catheter is attached to the rubber tubing coming from a reservoir similar to that for the bladder. A pint of fluid in the reservoir will usually be found sufficient. Distension is produced in the same way as for the bladder simply by elevating the reservoir two or three feet. When the bladder is opened, and while the tumour is being explored with the finger, the reservoir, already placed on the elevated stand, is connected with the rectal bag by removing

the clamp from the rubber tubing: distension to the necessary extent takes place in a minute or two.

It is no small recommendation of this method of distending bladder and rectum that it may be carried out from beginning to end, not only without any interference at the hands of the surgeon (beyond insertion of catheter and bag), but even while he is actually engaged in the cutting part of the operation. The tubes from the reservoirs being attached to the catheters in bladder and in rectum, he proceeds at once to make the parietal incision. It is now my practice not to begin distension of the bladder until the prevesical space is entered and the areolar tissue lying there is teased open and, with the peritoneum, is pushed upwards. While the forefinger, aided if necessary by forceps, is doing this, the reservoir is elevated; and the finger feels the bladder distending while it is pushing the fat and peritoneum out of the way. The sense of comfort and security that the gradually distending and hardening bladder gives can scarcely be over-estimated, while it absolutely does away with any but the most remote risk of injuring the peritoneum.

The Incision through the Parietes.—A vertical incision from two to three inches in length, according to the size of the patient, is made exactly in the middle line over the pubes. The lower end of the incision should pass below the upper border of the symphysis for a distance of at least a third of an inch. The thick fascia forming the linea alba being exposed, a small transverse incision is made through it close to the symphysis. This incision is made transversely, partly because it is the easiest and safest way of dividing the fascia, and partly because it at once exposes the actual division between the two recti, but chiefly because it opens up the field of operation, which is often cramped by the strong, tense and closely-set fibres. Through this transverse opening the point of the scalpel (or scissors) is insinuated, and the fascia divided upwards in the middle line to the top of the wound, the edge of the knife being directed forwards. The recti are now separated, and the transversalis

fascia appears, and is divided as in coeliotomy. At this stage one is usually struck by the great power of these muscles, and how vigorously they resist separation, even when the patient is fully anæsthetised. If their tension is so great as to hamper subsequent proceedings, part of their insertion into the pubic bones should at once be divided. This greatly increases the space. For the purpose of keeping the recti apart, I have devised strong wire retractors (Fig. 211), of different sizes, so shaped that they will retain their position when placed. One end of the retractor (the ends are of different sizes) is placed longitudinally in the vertical opening between the muscles; it is then rotated through quarter of a circle, so that its free end is over the pubes. By this action the recti are separated; the retractor is then pulled down towards the symphysis to be out of the way, and in this position it will remain without any attention. This instrument is very useful when considerable space is wanted by keeping apart the recti and opening up the field of operation: usually, however, it will not be required.

FIG. 211.

Retractor for Supra-Pubic Cystotomy.

When the transversalis fascia is divided, or rather the anterior layer of fascia which is continued downwards from the fold of Douglas, the yellow peri-vesical fat comes into view. The scalpel is now laid aside, and the forefinger, keeping close to the symphysis, and undermining it so to speak, teases apart the fat with the numerous vessels, mostly large veins, which lie in it. At this stage, while the pulp of the forefinger rests on the bladder-wall, the distension reservoir is elevated a foot or two higher, and the bladder is felt steadily to expand and to become more tense. While this is being done, the finger may sometimes feel the peritoneal fold gliding upwards quite plainly. The fingers during this process of final distension, aided, perhaps, by catch-forceps, will have teased the fatty and cellular tissue aside, and thoroughly exposed the wall of the bladder.   Much

of the tissue should be pushed upwards, carrying the peritoneum in front of it, and acting as padding and protection to that membrane. While the bladder-wall is gradually becoming more tense, and rising upwards, and the finger is teasing an opening in the fibrous tissue, the sense of touch somehow carries to the mind an impression of security, or rather of certainty, as to the positive limits of vesical tissue proper. Fat, fibrous tissue, and peritoneum may be moved about anywhere, but the bladder-wall itself remains stable and increasingly firm under all.

When a sufficient amount of bladder surface has been cleared we proceed at once to the next step.

Opening the Bladder.—Several methods of making the opening into the bladder are in vogue, and I have tried most of them. In several cases I have employed a Lister's sinus forceps for the purpose, first gently insinuating it through the outer muscular coats, and then sharply pushing it into the cavity. As the blades are separated the opening is distended, and the vesical wall may be pulled forward into the wound. I found that the opening so made was liable to be irregular and lacerated, and not suitable for subsequent suturing. A good many surgeons begin by placing thick fixation threads of silk in the bladder by curved handled needles, and make the division by knife while the bladder is pulled forwards. Besides the palpable objection to the making of more openings in the bladder than are necessary, there is another objection to the use of threads in the tendency which they have to tear the vesical tissue. Several other plans have been mentioned and recommended, but the best, on the whole, is probably by a clean incision made through the walls, which are held forward by a tenaculum. The tenaculum, held in the left hand, is pushed sharply through the coats, its entrance into the cavity being signalised by the exit of a few drops of fluid (if this fluid is tinted blue with litmus, it is more easily seen), and its point is turned upwards. Immediately below the tenaculum, into the same opening it may be, the point of a sharp scalpel, held in the right hand, is

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gently insinuated, and the opening made by a steady cut downwards. This opening will vary in length according to the work to be done through it : at first it need never be longer than an inch ; it may be extended afterwards. It must not be forgotten, however, that as the bladder empties, the peritoneal fold falls downwards, and it may then be difficult and dangerous to extend the opening in an upward direction. Therefore, the tenaculum should be inserted not lower down than the uppermost limit of the incision. It is sometimes not easy to define this limit. In a thickened and contracted bladder, which is not safe to distend, the supra-pubic interval may be short or absent, and the peritoneum has to be undermined, first downwards under the pubes and then upwards over the bladder, as in the operation for tying the external iliac artery. In such a case the urachus may often be felt as a round, somewhat tense cord, and a small knob representing its insertion into the summit of the bladder is occasionally perceptible. Peritoneum never passes the urachus ; it is always safe to go as high as this point. This practical hint, thrown out by Thornhill a century and a half ago, is by no means to be despised in the surgery of to-day.

As the opening is made the fluid flows from the bladder, and its walls collapse. To prevent retraction two catch-forceps are made to grasp the lips of the wound, and the tenaculum is removed. Loops of silk inserted by a needle are usually employed for this purpose ; the tendency of these to tear, and the formation of further openings in the bladder, are objections to the use of threads. At first I was afraid that the pressure exerted by the blades of the forceps might cause sloughing. True, proof against this is abundantly afforded in the fact that catch-forceps are constantly being left hanging to pieces of tissue for long periods without endangering their vitality ; and, as a matter of experience, forceps do no harm whatever. Compression need not be employed to the fullest extent, and traction must be no more than sufficient to keep the bladder opening upwards in the parietal opening.

Placing the forceps is very quickly done, and not much of the fluid will in the meantime have escaped. It matters very

little, however, if the whole has escaped. If, as can seldom be the case, it is desirable to explore with the bladder full, the finger can at once plug the opening, and the bladder may be refilled simply by permitting the distending apparatus to work.

Intra-vesical Manipulations. — These vary according to the purpose for which the operation is performed; namely, removal of a stone, a foreign body, or a tumour, or the hypertrophied prostate gland.

Extraction of Calculus.—The extraction of a calculus by the supra-pubic route is usually a proceeding of the simplest possible nature. If the rectal bag is not employed, and the lips of the wound in the bladder are held forward in the grasp of catch-forceps, the bladder when empty will form a simple elongated sac, at the bottom of which the stone will be found.

In children, where the stone is usually small and the bladder walls lax and distensile, extraction may be performed with great ease. Some surgeons recommend the employment of the fingers, or the finger with a scoop, for removing the stone; I should advise the use of small lithotomy forceps. The finger or fingers quite unnecessarily add to the dimensions of the body to be extracted, and so cause needless dilatation or tearing of the wound in the bladder. Forceps of proper dimensions, while quite efficient for the purpose, do not add to the bulk of the stone so much as the fingers. Nearly always the stone is caught between the blades at the first trial, without the insertion of the finger at all ; if there is any difficulty in grasping the stone, the finger introduced along the blades may place the stone between them, but should be removed before the stone. In view of the extreme desirability of getting union of the vesical wound in children, it is important that there should be as little traumatism and as small an opening as possible. The rectal bag raises the base of the bladder so as to make it become convex towards the front ; the stone falls off this convexity into some part of the encircling sulcus, and is not so easily found as when the bladder remains as a simple sac. However, in very few cases can the

finding of the stone be difficult. In cases of real difficulty, as when the stone is encapsuled, the finger in the rectum is the best means of pushing the stone out of its bed.

In adults, and particularly in old men, the stone in most cases will be very large, the bladder walls very thick, and perhaps ulcerated, and the situation of the viscus will be well back in the hollow of the sacrum. Vesical distension to any great extent will then be either dangerous or impossible, and the incision through the front of the bladder will probably at once expose the stone. It is then a question of how to remove the stone through the smallest opening, and with the greatest possible delicacy. Towards this end, one or two fingers in the rectum are more useful than the rectal bag. One or two fingers of the right hand in the rectum, with the fingers of the left hand through the bladder wound, may, by judicious and careful manipulation, disturb the stone from its bed, and place it so that its smallest diameter lies transversely to the bladder wound. By the combined manipulation the stone may often be pushed out of the bladder; if manipulation do not readily succeed, a suitably shaped lithotomy forceps may be made to grasp it, and help in the extraction. Force must not be employed; if the vesical walls appear to be stretched, and likely to tear over the shoulders of stone or forceps, they must be divided by a scalpel cutting down on the stone or the steel to what extent is necessary. In this operation there is no excuse whatever for the production of bruising or laceration. If the stone is of small or moderate size, it may readily be removed by forceps without the aid of the finger in the rectum or in the bladder.

Extraction of Foreign Bodies.—Here the insertion of the finger for exploratory purposes is always advisable. The nature of the body, and the possible existence of ulceration or even perforation of the vesical walls by sharp points, are made out. According to the information thus conveyed the mode of removal is decided upon. A small, blunt, or rounded foreign body may easily be removed by forceps. A long foreign body which cannot easily be tilted on end should, if possible, be divided. In such

manipulations we must always bear in mind the possibility of perforating the bladder, and proceed with extreme circumspection. If actual perforation exists, or is produced, the parietal incision should at once be prolonged upwards, the peritoneal cavity opened, and the wound in the bladder sutured in the manner to be described for rupture of the bladder.

Removal of Tumours.—Most tumours may be removed with the instruments provided for the general operation. Medium-sized Wells' forceps, with blades set at right angles to the handles, will be found useful for grasping pedunculated tumours at their attachment to the bladder, and for twisting them off. Volkmann's spoons or ordinary curettes will be necessary where scraping is employed. Sir Henry Thompson invented several special forceps for removing tumours by the perineal route (Fig. 212); these may be found useful in the hypogastric operation. The electric light introduced into the bladder may be useful for examining the tumour before removal, or the pedicle after it has been removed.

FIG. 212.

Thompson's Forceps for Removing Tumours of Bladder.

Polypi should be twisted off. A bent catch-forceps, guided by a finger of the left hand, is made to grasp the pedicle close to its attachment to the bladder, and handed over to an assistant. A second similarly shaped forceps is placed on the growth immediately above the first, and twisted round, while the lower forceps is held stationary until the pedicle is twisted through. Small polypi may be at once twisted off the bladder. Large polypi are, I believe, most safely removed by twisting between two pairs of forceps. The twisting of a tumour with considerable attachments to the vesical walls of necessity does considerable injury to the tissues, and may result in ulceration or sloughing of the vesical

walls. The red-hot galvanic wire has been used for the purpose of dividing the pedicle.

Papillomata with pedicles are most conveniently removed by twisting, as described for polypi. Small, very soft dendritic papillomata are best removed by scraping or curetting between a suitable instrument and the forefinger. Indeed, the finger-nail alone will suffice for the detachment of many of these tumours. Of larger size, these growths must be attacked with sharp spoons or forceps, like the "gouge" bone-forceps (which suits admirably). A fibro-papilloma is detached piecemeal by scoops or curettes guided and assisted by the finger. If a pedicle can be grasped it may be twisted off. Epithelioma can only be scraped and curetted in the same way. Most of these tumours lie on a bed of hypertrophied muscular tissue, so that there is little danger of perforating the vesical walls; still, the finger should always be alongside the instrument, to make certain that it does not advance too far.

Detached tumours are subsequently removed by the stream of fluid sent into the bladder through the irrigator. It unnecessarily adds to the length of the operation and the traumatism to remove every particle from the cavity as it is detached.

Bleeding in these cases, though sometimes free at the moment, rarely continues over any length of time. Should it continue, and be at all alarming, a careful application of the actual cautery to the bleeding area through a small cylindrical speculum is probably the most effectual and least harmful mode of checking it. Topical application of powerful astringents may set up troublesome cystitis.

It must be noted that benign tumours of the bladder have a tendency to return. Recurrence has taken place in at least one in five of all the cases operated upon. This was Guyon's proportion in 15 cases of operation; and a study of scattered cases, including those of Sir Henry Thompson, shows a similar proportion. Looking at the condition which obtains in cases of numerous soft scattered polypi, this is not at all surprising; for many of these tumours must be imperceptible to the sense of touch, or even microscopic. Recurrence in these cases may be a con-

tinued growth of imperfectly removed ones. Repeated operation may then result in perfect cure. In the larger single growths, recurrence is most likely a sequence of imperfect removal. In the case of epithelioma that is scraped, we can expect nothing more than temporary amelioration of symptoms. In one such case on which I operated, the amount of relief from pain and tenesmus which followed, and continued for nearly six months, surprised all concerned in the treatment. If the pain and tenesmus had recurred, the patient would certainly have requested repetition of the operation : death took place from hæmorrhage.

In the case of malignant tumours involving the fundus, the propriety of resection would have to be considered. This will be dealt with further on.

Prostatectomy.—In McGill's last description of his operation,[*] three distinct varieties of prostatic enlargement are described as being possible indications for operation. They have all one common characteristic—" they are all growths which protrude into the bladder cavity, and may consequently be described as vesical and not as perineal outgrowths." The varieties are— "(1) A uniform circular projection surrounding the internal orifice of the urethra. . . . (2) A sessile enlargement of the middle lobe, situated partly in the posterior half of the prostatic urethra and partly in the position of the uvula vesicæ. . . . (3) A pedunculated enlargement of the middle lobe."

" The operation consists of two parts : (1) The opening and drainage of the bladder ; and (2) the removal of the prostatic valve, which prevents the egress of urine." For the fulfilment of both these conditions the supra-pubic operation is the best. This is performed in the way described above. The rectal bag should be employed. The neck of the bladder and the region of the prostate are carefully examined by the finger, and the actual variety of enlargement diagnosed. According to the nature of the enlargement we adopt measures for its removal. " A pedunculated middle lobe can obviously be removed with

[*] *Lancet,* Feb. 4th, 1888.

ease, its pedicle being divided with curved scissors. A sessile middle lobe can be removed in the same way, helping the scissors by tearing with forceps. The collar enlargement is removed with greater difficulty. It is, I think, advisable to divide it longitudinally by inserting one blade of the scissors into the urethral opening and dividing the portion above, and then passing the other blade into the same opening and dividing the portion below. We now have that part of the gland which projects into the bladder divided into two lateral halves; these can be removed separately by scissors curved on the flat, or enuncleated with the tip of the forefinger. Care must be taken not to leave any portion of the projecting valve untouched. When the operation is completed, whichever form of growth has been removed, it is advisable to see that the urethra is patent, and to pass the forefinger, as far as the first joint, into its canal." Hæmorrhage is not excessive, and may easily be arrested by the injection of a hot antiseptic solution. The bladder is drained by a rubber tube carried out through the lower angle of the wound, which is removed at the end of forty-eight hours.

Many variations in the method of removing the enlarged portion have been described. In each case the surgeon will use a method which in his judgment seems to be most likely to be successful. Where the urethral orifice is surrounded by a ring of enlarged gland, Mayo Robson recommends that a V-shaped piece should be excised from the floor by means of McGill's scissors. Enucleation by the fingers, or by fingers and forceps, is employed wherever possible, and is very successful. An enlarged median lobe has been removed by écraseur, either passed through the urethra or through a perineal incision.

When intra-vesical operations are concluded, the bladder is washed out by irrigation through the catheter still lying in the urethra. The lotion in the reservoir will by this time have cooled down, and a sufficient amount of hot water to raise it to the temperature of the body should be added. As the lotion flows out through the hypogastric wound it may be collected either in sponges or wet cloths, or in a properly shaped vessel

held under the wound while the patient is turned a little on one side. Fragments of growth and pieces of blood-clot are washed away in the stream. Irrigation may be stopped when the lotion returns as clear as when it left the reservoir. ·

Suturing the Wound in the Bladder.—The propriety of suturing the bladder wound has been very much discussed. Some surgeons absolutely condemn the proceeding under all circumstances ; others as universally recommend it ; while a third class would limit its application to suitable cases selected according to the judgment of the surgeon, guided by the leading principles of sound surgery.

It is unnecessary to follow the numerous arguments for and against the operation of vesical suture.* It may here be remarked that many of the condemnatory arguments are based on erroneous and imperfect modes of suturing, and should not prevail against well-devised modes ; while too hasty generalisations in favour of suture in general are based upon one or two successes in particular instances.

That successful suture of the bladder, followed by primary union, greatly adds to the comfort of the patient and the rapidity of recovery there can be no dispute. And, if a suffi-ciently large number of cases could be compared, no doubt it could be shown that it adds to the chances of recovery as well. To base an argument (as has been done) in favour of the reduced mortality after suture is misleading ; because suture has been applied chiefly in the most favourable cases and in children. On the other hand, although it would be difficult to prove it, there can be no doubt that an injudicious application of the suture adds to the patient's danger.

In speaking of the indications and contra-indications to the employment of vesical suture, only very general statements can be employed. We must take into account such circumstances as the condition as to health or disease of the vesical walls, with respect to their capacity for uniting ; the condition of the

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* Those desirous of pursuing the subject will find it exhaustively handled by Gross of Nancy in the *Memoires du Congrès Français de Chirurgie.* 2e Sess. Paris, 1886.

vesical mucous membrane, as to whether it is likely to secrete inflammatory products ; and the power of the bladder-muscle to contract and empty the viscus.

In more than one case primary union of the bladder wound has taken place without the employment of any suture.*

In cases where the vesical tissues are greatly thickened or inflamed or œdematous or engorged with blood, no attempt at suture should be made. Such an attempt will almost certainly fail to give union, and will unnecessarily add to the traumatism. In other cases, chiefly of very large stone, there may exist ulcers or abrasions on the mucous surface in the region of the wound : here also suturing is not likely to be successful, and may aggravate the ulceration, and even cause sloughing. If cystitis has existed for some time, and we apprehend the secretion of muco-purulent products into the cavity after operation, suture should not be employed. Drainage is, in fact, one means of treating this inflammation ; and even if suture were successful, the cure of the inflammation through the urethra with a closed bladder is not likely to be so rapid as through the bladder wound. Finally, if, from repeated or long-continued overdistension or inflammatory infiltration, the vesical muscle has lost its tone, and cannot completely empty the viscus, we should hesitate before adopting primary suture. Such a case would be where there is excessive hæmorrhage, and the bladder is frequently filled to distension with clotted blood which cannot be passed in the urine. Even with a catheter passed through the urethra into the bladder, residual urine collects, and will undergo decomposition and cause cystitis.

On the other hand, given a case in which the tissues in the wall of the bladder are healthy, the muscles capable of contracting naturally, and the mucous membrane not likely to secrete inflammatory or noxious products, then we may suture the bladder wound. The great majority of these cases will be found in children with calculus which has not set up much cystitis. In adults with bleeding tumour which is not associated with inflammation, another class favourable to vesical closure

* *Amer. Pract. and News*, Feb. 16, 1889.

will be found. In old men, the most favourable conditions to suture can scarcely be found with stone, and rarely with tumour. The practice of complete closure of the wound in the bladder will, therefore, be mainly confined to children. A mode of partial closure, suitable for doubtful cases, and advisable with the view of closing up opened areolar spaces, will be described. A good many are best treated without any suture at all, while the bladder is, as far as possible, maintained in the condition of an open and exposed wound. One purpose of suture of the bladder is to prevent infiltration of urine: if the suturing is not perfect, it adds to the danger of infiltration; and the risk therefrom being greatest in old men with unhealthy bladders, in these the treatment by open wound is most frequently called for.

Of modes of suturing the bladder, a good many have been described. In most the practice adopted has been founded on the principles which guide the suturing of wounds of the intestine. It may be pointed out that the outer coverings of the bladder in this operation are not peritoneal, and do not exhibit the same tendency to rapid healing; that the whole bladder wall is thicker than the intestine, although perhaps it is not more tough; and that the mucous membrane of the bladder, unlike that of the intestine, is too thin to act as a plug against the escape of fluid. Further, the actual line of incision in the bladder, if cleanly cut and straight, provides two broad surfaces of tissue prone to unite if properly approximated.

One of the most ingenious modes of suturing the bladder is that described by Maynard.* The sutures are placed in two double rows by a special needle before the bladder is opened, and are used, during the opening and in the subsequent manipulations, to pull the bladder-walls forward. An obvious objection to this plan is, that by the traction the stitch-openings are stretched and dilated. The important advantages of his plan are, that it gives apposition, not only at and beyond the margins of the wound, as in Lembert's mode, but also at the cut edges. The most generally adopted plan is Lembert's.

* *Glasgow Med. Journ.*, Dec., 1887.

I should, with Maynard and a good few others, here prefer chromicised gut to silk as suture-material. Suture holes in the bladder are more likely to leak than in the intestine, for the reasons that the plug of mucous membrane below them is not so efficient, and that sealing up of the openings by exuded lymph is not so rapid. The gut swells and blocks the opening ; and if it should come in contact with the urine, does not carry it through the tissues by capillary action as silk does. Chromicised gut will last for a week or ten days at least, and by this time the full benefit of suturing will be secured. Ordinary carbolised gut is too rapidly absorbed.

I would recommend the application of a double row of sutures : the inner row to transfix the cut muscular surface, but not the mucous membrane ; the outer row, after the manner of Lembert. Two blunt tenacula or aneurism needles are placed, one at each end of the wound in the bladder, and handed over to the assistant while the catch-forceps are removed. The wound is gently kept on the stretch by this means, and the walls at the same time kept forward. A round semicircular needle, with piercing but not cutting point, held in a needle-holder, is the best instrument for inserting the stitches. Each suture passes through the edge of the wound obliquely from the outside, close to but not piercing the mucous membrane, and picks up as much of the muscle as possible without encroaching too much on the limit to be covered by the second row of sutures. These stitches are, in fact, placed in a manner not unlike the "flange-stitch" of Tait. This stitch would, in fact, be the best of all were it possible to separate the wall of the bladder into layers, and were the friable muscle competent to bear sufficient strain ; the approximation to flangeing described would probably be the best practical method. About four stitches to the inch are inserted in this way. While the tenacula continue to hold the wound forwards the second row is now placed, after Lembert's method, the terminal stitches passing a little way beyond the ends of the wound. They should alternate with the stitches of the inner row. When inserted the ends of the sutures are gathered together in the

hands of the assistant, the tenacula are removed, and the sutures are then tied systematically from one end of the wound to the other. When all have been tied, their ends are cut off, and the bladder permitted to fall backwards to its normal position when empty. The whole supra-pubic space is now thoroughly cleansed of blood and fluid, and the tap from the irrigating reservoir opened, so as to distend the bladder and test the efficiency of the suturing.

There is no objection to the employment of the continuous Dupuytren suture, if the surgeon thinks it can be properly applied. I have on two occasions employed it to supplement an interrupted suture, and found primary healing to follow.

The parietal wound is now sutured, after a drainage-tube has been placed over the line of suture in the bladder. If the ends of the recti have been divided, a good deal of tension may be required to bring the lips close; it is better to have a little space gaping, than exert too much traction. The tube not only drains the exudations from the supra-pubic space, but acts as a safeguard in the event of the suturing of the bladder not proving perfectly efficient, and some of the urine escaping.

Partial suture of the bladder is not recommended unless the bladder is at the same time sutured to the parietes, as in the ordinary treatment of an abdominal cyst which is not removed. In old men the bladder lies low and far back, and it prevents unnecessary infiltration of urine to have the fundus kept well up in the wound by means of a stitch or two. I have on three occasions treated the bladder in the same way as the peritoneum in coeliotomy—including its walls bodily in the stitches which pass through the parietes. On several occasions I have spoken of the possible advantage of treating the whole bladder-wound in this way; but the lower part of it I have always found to lie too low down to be easily brought up to the parietes. Engelbach and Rollin* have written in favour of this combined mode of suturing bladder and parietes, while a drainage-tube resting on the bladder passes through the middle of the wound. The risk of this method is that drops of urine passing along the

* *Ann. des mal. des org. gén. urin.*, Sept., 1887, and *Med. Chron.*, Dec., 1887.

stitches may get into the peri-vesical space.   One or two stitches
at the top of the wound placed in this way could do no harm,
and might, by keeping the bladder forward and diminishing the
wound-area, do much good.

Many modifications in the operative methods have been
carried out.   One which may specially be mentioned is, for
certain cases, to deliberately enter the peritoneal cavity and
open the bladder through its peritoneal aspect.   This would
not be an operation of choice but of necessity with most
surgeons.

After-treatment.—If the wounds are sutured, an ordinary
dressing is applied, and fixed by strapping.   Many surgeons
recommend that the bladder be kept empty by wearing a
catheter in the urethra.   Theoretically, this is sound ; but
practically, in children at least, I am convinced it is best to
leave the bladder to its fate, and let the patient pass water
when he desires to.   I have on two occasions seen blocking
of the catheter cause that very over-distension which we wish
to avoid, and on the first occasion on which I dispensed with
the catheter I got perfect primary healing.   Barker and others
have come to the same conclusion ; and, therefore, in every
case where the patient is young, and the bladder-wound has
been satisfactorily sutured, I should dispense with the catheter
fixed in the bladder.

If the wound is not sutured it is freely dusted with iodoform
or boracic acid powder, or smeared with boro-glyceride, and
covered with large pads of absorbent dressing.   The value of a
drainage-tube in the bladder is doubtful; I have thought that it
causes irritation sometimes, and if the lips of the wound remain
open, I dispense with it.   A piece of rubber tubing acting as a
syphon in connection with a vessel by the bedside below the
level of the patient has been suggested as a means of keeping
the bladder empty.   As soon, however, as the fluid in the
bladder was exhausted the syphon action would cease.   If it
is desirable to keep the bladder empty, this can be done by
capillary action, using a small roll of gauze or cotton inside a
drainage-tube as in cases of coeliotomy.   The dressing is fixed

with two long pieces of strapping, and the patient is permitted to lie in any position he pleases. Intra-abdominal pressure is quite sufficient to keep the bladder empty, and force the secreted urine out at the wound ; the urine has no more tendency to collect in the bladder in the supine than in the lateral posture. Change of position is adopted simply because it adds to the patient's comfort.

If primary healing after suture takes place, the sutures may be removed at the end of a week, and the patient permitted to get up in ten days. If localised redness and swelling appear in the supra-pubic incision, the stitch or stitches in this area should at once be removed. In some cases a few drops of urine trickle out through the wound, to be followed by the formation of a small fistula, which spontaneously closes in a few days. If the fistula is large, so as to permit passage of all or the greater part of the secreted urine, healing will probably not take place for three weeks or a month. In children, even if the bladder-suture has completely failed, perfect healing is rarely delayed longer than three weeks. In any case the child may be permitted to get up and run about at the end of a fortnight. In one of my patients in whom primary healing was almost, but not quite perfect, a free discharge of blood took place into the bladder at the end of ten days. Similar experiences have been recorded by others. Obvious explanations of this peculiarity suggest themselves, but, in the absence of anything like clinical proof, had better be withheld.

If the wound is not closed there is sometimes a tendency for mucus and inflammatory products to collect in the bottom of the vesical sac. These should be washed out as often as necessary by means of the irrigator. The wound and everything in its neighbourhood should be kept sweet by frequent cleansing and the employment of suitable germicides. At the end of a few days, if the patient will bear it, he may be lifted on a sheet into a warm hip-bath, placed by the side of his bed, and left there for half an hour or more. If this can be done daily, it not only adds to the patient's comfort, but serves thoroughly to cleanse the parts.

Resection of the Wall of the Bladder.

Sonnenberg[*] was the first to perform this operation, and related his case at the Fourteenth Congress of the German Society of Surgeons in 1885. Von Antal of Budapest[†] performed a partial resection in April, 1885; and Radzimowski, a Russian surgeon, published in the *Kief Vrach* for 1886 a similar operation.

Sonnenberg's operation was performed on a man aged sixty, who had a malignant tumour in the anterior wall of the bladder. The supra-pubic operation was performed in the usual way; and the tumour was found to have so broad a base that, to remove it, it was necessary to resect nearly two-thirds of the wall of the bladder. The tumour was removed in portions, and the peritoneal cavity was opened. The bladder wound could not be closed; but the peritoneum was carefully brought together by sutures over it. The bladder was drained both by the urethra and by the parietal wound. The patient lived four weeks, and died of asthenia. At the post-mortem it was found that a new and water-tight cavity had formed, which seemed capable of being distended.

Von Antal's case was a sub-peritoneal resection. His patient was a man aged sixty-one, and to remove the growth about one-third of the wall of the bladder had to be removed. The operation was retro-peritoneal, the whole area of the viscus invaded by the tumour having been peeled from the peritoneum. Several bleeding vessels had to be tied during the operation. The edges of the wound in the bladder were closed by silk sutures, drainage tubes were inserted, and the wounds treated by constant irrigation with thymol solution. The patient made a good recovery, with a fairly capacious bladder, but died of recurrence a year later.

* " Zur partiellen Resection der Harnblase," *Verhandl. d. Deutsch. Gesel. f. Chir.*, 1885, XIV. 12.   † *Centralbl. f. Chir.*, 1885, p. 617.

Barling,* in an exhaustive paper dealing with the whole subject of carcinoma of the bladder, refers to other operations by Bruce Clarke and Guyon. Guyon did not excise the whole thickness of the bladder wall; his patient died of recurrence after four years.

Albarran,† at the French Academy of Medicine, showed a patient on whom he had performed resection of the bladder after symphysiotomy. Two years previously he had removed a pedunculated neoplasm by supra-pubic operation; on recurrence of symptoms, cystoscopy revealed epithelioma near to the neck of the bladder. A ⋏-shaped incision was made, division and separation of the pubic symphysis were carried out, and the left lateral and inferior portions of the bladder were excised. The wound was closed by a double row of sutures, and after a temporary fistula had healed, an excellent result followed.

Weir of New York‡ records three cases of partial cystectomy. In one he removed a triangular portion of the bladder measuring $2\frac{1}{2}$ inches on the sides, and, finding it impossible to suture the lower part of the incision, drained the peritoneum with iodoform gauze. This patient died in seven weeks. In another case the growth, carcinoma, occupied the summit of the bladder chiefly; he peeled the peritoneum, removed the growth, drained the abdomen by gauze and the bladder by rubber. The patient recovered.

Where large amounts of the bladder have to be removed or where suture is impossible, it is important to know that Schwarz§ has shown experimenally that after removal of the whole bladder except the parts around the ureters, nature may form a new organ whose walls are inflammatory tissue, which is serviceable.

In all such operations, the feasibility of drainage of the ureters, whereby the bladder is placed at rest and relieved of its duties as a distensile and contractile receptacle, is forcibly presented to the mind of the surgeon. Pawlik has drained the

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* *Birming. Med. Rev.*, Mar., 1890.   † *Sem. Med.*, Jan. 18, 1893.
‡ *New York Med. Rec.*, Aug. 11, 1894.
§ *Lo Sperimentale*, xlv., fasc. 5, and *Rif. Med.*, July 3rd, 4th, and 5th, 1894.

ureters for 48 hours, Schede for 7 days, and Albarran for 10 days. Willems, in particular, has advocated this proceeding by means of a special Y-shaped double catheter. Two of Howard Kelly's ureteric catheters (p. 878) might conveniently be used for such a purpose, and could be laid in the urethra or in a supra-pubic opening. Ureteric catheterisation even for 24 hours would be of conspicuous advantage in all cases of vesical resection ; if it could be carried out for two or three days till the vesical wound is healed, it would probably contribute more towards success than any individual element in the operation.

In carefully selected cases there can be no doubt that partial resection of the wall of the bladder is both feasible and proper. The most satisfactory operation would be where the tumour lay entirely in the anterior wall, when it could easily be removed without encroaching upon the peritoneum. A tumour lying behind the summit of the bladder may be resected if it does not involve too large an area of the walls, and does not lie too close to the ureters or encroach on them. Removal in portions, as done by Sonnenberg, does not commend itself to me ; and sub-peritoneal resection can rarely be advisable if the tumour deeply infiltrates the bladder tissues, for then the peritoneum is likely to be invaded with the new growth. Complete excision of growth, bladder-wall, and peritoneum by a cutting operation would probably be the best plan where that is possible. I should make an attempt to bring the growth well into the bladder wound by means of catch-forceps : then by longer forceps with angled blades pinch up the healthy bladder-walls behind it, and endeavour to make a closure of the healthy walls all round by means of a shoemaker's stitch, so as to close the bladder behind the tumour before cutting it away. The supra-pubic incision should always be prolonged into abdominal section, and the bladder wound is then more thoroughly closed by Lembert sutures placed on the outside. While this is being done, a sponge should be placed inside the viscus to make it bulge into the abdominal cavity, and also to soak up the secreted urine ; and the bowels should be well protected by soft flat sponges placed inside the abdomen. The actual details of any

given operation can scarcely be described; the variations in individual cases would be more numerous than the rules. Complete excision of the growth is the first essential; perfect closure of the vesical wound is the next desideratum; drainage of the ureters should always be attempted; and gauze drainage of the abdomen with supra-pubic drainage of the bladder should be resorted to wherever it is deemed advisable.

Section X.

OPERATIONS ON THE LIVER, THE GALL-BLADDER, AND THE BILIARY DUCTS.

SUMMARY.

OPERATIONS ON THE LIVER, THE GALL-BLADDER, AND THE BILIARY DUCTS.

SURGICAL ANATOMY.

THE surgery of the liver being concerned largely with diseases which cause enlargement of the organ, it behoves us to know accurately the limits of the space which it normally occupies. The limits of percussion dulness, relative and absolute, are well enough known ; but as the organ is over-lapped by lung above, and as it overlaps air-containing viscera where it is thinnest below, these limits may not be anatomically precise.

On the right side, a transverse line passing through the junction of the fifth rib with its cartilage would graze the top of the right lobe at its highest point. In fact, the highest level of the liver almost touches the lower border of the fourth rib. On the left side, a transverse line running through

the junction of the sixth rib with its cartilage would pass close to the upper and outer limits of the left lobe. Below, its margin is just covered by the ribs behind : as it comes to the front, it leaves the cartilage of the tenth rib on the right and crosses obliquely to the left, towards the junction of the fifth left rib with its cartilage.

A triangular area of liver surface is thus left uncovered by anything but abdominal wall ; and it is in this area, usually increased in dimensions, that many surgical procedures have to be carried out. The sharp free margin, with its notch a little to the right of the middle line, indicating the attachment of the broad ligament, may frequently be palpated. From the notch to the umbilicus runs the double fold of peritoneum known as the longitudinal or suspensory ligament. Its parietal attachment is along the inner border of the right rectus muscle ; its free border contains the fibrous cord known as the round ligament, which is the remains of the obliterated umbilical vein. At the notch the round ligament passes behind the liver along the longitudinal fissure. It must not be forgotten that the umbilical vein is not always completely obliterated, and that a wound in it may cause hæmorrhage. This fact must be noted in the making of long incisions in the region.

The extent to which the right lung and pleura overlap the liver varies considerably in health. When the liver is enlarged it rises upwards, encroaching on the pulmonary space : but though the level of the upper surface is raised both actually and to percussion, and though the lung may be pushed up in front of it, the diaphragmatic pleura still retains its position. A puncture above the normal level of the lower limits of the pleura, or the insertion of the diaphragm, though it may not pass through lung, will traverse the pleura, and, if there are no adhesions, will enter the pleural cavity. The level of the pleura in the right axillary line is at the lower border of the ninth rib ; and if variations occur on this side as frequently as they do on the left side, we must not be surprised to find it placed lower.

The liver possesses some range of movement. Following the movements of the diaphragm, it descends with inspiration

and ascends with expiration. If there is occasion to stitch a wound in the liver to the parietes, the evil effects of this continual movement may be minimised by fixing the sutures at a distance as great as possible from the rib margins. Unimportant displacements take place as the position of the individual varies, and as the abdomen is compressed or relaxed. A real pathological displacement is seen in the rare condition known as wandering or floating liver. Though most of the cases so described have proved to be errors in diagnosis, a few, perhaps a dozen, are attested by post mortem examination or incontrovertible physical signs.* In the great majority of cases the condition has been found associated with pendulous abdomen. In none is treatment called for beyond the wearing of an abdominal belt.

The structure of the liver is such that we should expect it to be intolerant of surgical interference. But experience would seem to point the other way. Its capsule is very closely adherent, and so thin as to be incapable of bearing much strain from sutures. The tissue is very friable and very vascular ; but the blood-stream is very sluggish, and easily controlled by pressure such as may be exerted by sponges or a row of sutures.

The gall-bladder (Fig. 214), lying on the under surface of the liver in a shallow groove between the lobulus quadratus and the right lobe, is, when healthy, beyond the reach of palpation. Its fundus extends a little lower than the edge of the liver, and lies in a shallow depression, whose margin can sometimes be felt below the inner border of the ninth costal cartilage. In this position it is a little to the right of the outer margin of the right rectus muscle, and can be reached by an incision through the upper end of the right linea semilunaris.

The bladder itself is about four inches in length, and about an inch broad, with a normal capacity of a little over an ounce.

* Consult Thierfelder, Ziemssen's *Cycl.*, vol. iv., p. 48. Landau, *Der Wanderleber und der Hängerbauch der Frauen.* Berlin, 1885. Larïonoff, Rubinovitch, Dmitrieff, and Botkin ; Abstract in *Lon. Med. Rec.*, Aug. 15th, 1885, by Dr. Idelson, who gives further references.

It is fixed to the under surface of the liver simply by the peritoneum, which passes over it.   Occasionally the peritoneal folds meet on its upper surface between it and the liver, forming a sort of mesentery.   On one occasion when performing cholecystotomy on the cadaver, I found a double fold of peritoneum passing between the free surface of the bladder and the inferior margin of the foramen of Winslow.   As another, though less

Fig. 213.   (Thane.   Morris's *Anatomy*.)

Relation of Structures at and below the Transverse Fissure.

perfect, example of this anomaly was found in the post-mortem room within a few months, I suspect that this condition is not very rare.   This abnormality need not interfere seriously with operative proceedings ; but if met with unexpectedly, it might be confusing.

The cystic duct, about an inch long, leaves the neck of the bladder at a very obtuse angle, passes a little towards the left in the gastro-hepatic omentum, accompanied with its artery, and joins the hepatic duct at an acute angle.   These, joining, form the ductus communis choledochus, which, after a course about three inches long in the right border of the lesser omentum, passes with the pancreatic duct obliquely through the inner wall of the descending portion of duodenum.

The surgical anatomy of the common duct has been minutely studied by Christian Fenger* ; his description is quoted :

* *Amer. Journ. Med. Sc.*, Feb. and Mar., 1896.

"The common duct is 6 to 7 cm. long, runs in an oblique direction, forming an angle of 45° with the frontal plane of the body, and when it contains a stone or stones is ordinarily dilated. It is thus 15 to 20 mm. in diameter, and may be divided into three portions, each 2 to 2½ cm. long.
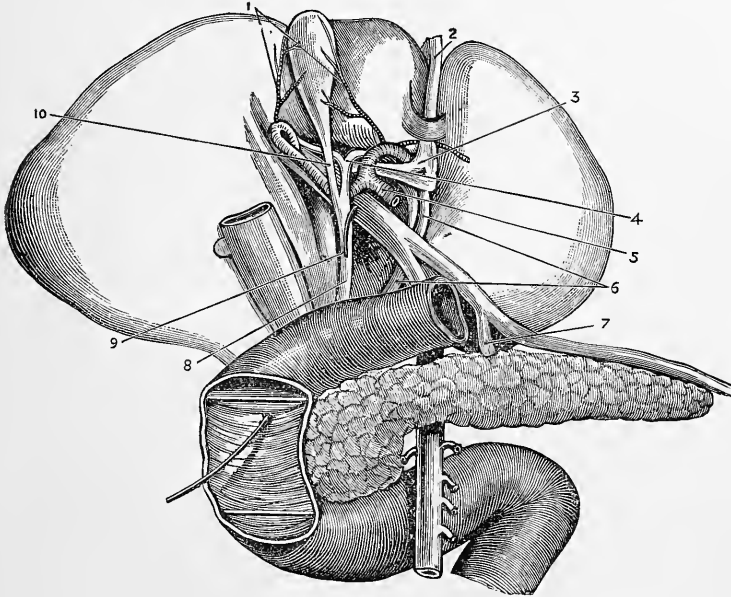
FIG. 214. (WEISSE.)

The under surface of the Liver; the Duodenum and the Pancreas.

1. Cystic Arteries supplying Gall-bladder. 2. Obliterated Umbilical Vein. 3. Obliterated Branch to Vena Portæ. 4. Hepatic Duct. 5. Hepatic Artery. 6. Obliterated Ductus Venosus. 7. Inferior Mesenteric Vein discharging into the Splenic Vein. 8. Ductus Communis Choledochus. 9. Probe entering the Duct and coming out at the Orifice in the Duodenum. 10. Cystic Duct.—The inferior Vena Cava is crossed by the lines from 8 and 9. The superior Mesenteric Vein crosses the transverse portion of the Duodenum and passes under the Pancreas to join the Splenic Vein in the Vena Portæ.

"The upper or anterior portion, nearest the hilus, begins at the junction of the cystic and hepatic ducts. Its upper half is partially covered with the main trunk of the vena porta, which gradually retreats from its anterior to its posterior surface, to disappear behind the common duct at about its middle.

"The middle portion has no vena porta on its anterior

surface, but the upper half of the lower or right border is overlapped by the retreating vena porta. At its upper or left border the hepatic artery passes behind it on its way to the hilus of the liver, and at this point gives off a branch which passes forward on the anterior surface of the common duct, where it divides into two branches, one of which runs upward and to the right to the cystic duct, the other downward and to the left on the anterior surface of the lower half of the common duct. This middle portion of the common duct, the anterior surface of which is not in relation with the vena porta, is the place of choice for the incision in choledocholithotomy, as at this point only small branches of the vena porta and hepatic artery are met with—vessels too small to cause serious or uncontrollable hemorrhage. Its upper border, together with the right free border of the duodenum and the hepatic artery, forms a triangular space.

"The third, lower or posterior portion of the duct is almost entirely hidden by the duodenum which covers its anterior surface and its entire upper border for 2 to 2½ cm., while only 1 to 1½ cm. of its lower border is covered by the intestine. This part of the duct lies partly in the head of the pancreas. Its lower end is, as a rule, dilated and forms a cul-de-sac, usually a little smaller than the duct higher up, and at some place in this cul-de-sac (the dilated diverticulum Vateri) the opening into the duodenum is situated. The possibility of passing a sound down into the intestine from the incised common duct depends upon the situation of the duodenal opening in this cul-de-sac, and upon the direction of the canal through the wall of the duodenum. In some cases it is easy to pass a sound down, in others impossible, although the opening may allow free exit to bile (this may be due to valve-formation or to the fact that the probe or bougie is caught in a fold). The head of the pancreas overlaps or comes down below the lower border of this portion of the duct for 1 cm. or more."

The fibrous coat of the gall-bladder, though thin, is very strong and tough, and is not easily dilated. The thin layer of muscular fibres is arranged mainly in longitudinal direction.

The mucous coat is everywhere elevated in ridges, which are so arranged as to produce polygonal depressions, most highly developed near the middle of the cavity. At the neck, one large ruga overhangs the entrance to the cystic duct, and acts as a sort of valve. When the bladder is over-distended, these rugæ are usually obliterated. In the cystic duct the mucous membrane is raised into half-a-dozen or a dozen oblique folds, arranged so as to form a sort of interrupted spiral. These folds increase the difficulty of gall-stones being passed onwards. Any distension of the duct causes the intervalvular spaces to be distended, producing a sort of cork-screw appearance.

The relations of the bowels to the gall-bladder are unimportant, except in view of the operative formation of a fistula between the two. This will be discussed farther on.

Operations on the Liver.

Surgical operations are performed on the liver for abscess and for hydatids: rarely also for solid growths. The operations are various: most of them are of the nature of proceedings for the evacuation of cystic collections of fluid. Although most of the proceedings involve wounding of liver tissue, the special name "Hepatotomy" is given only to that operation wherein the parietes are divided, and the liver tissue is directly incised through the parietal wound. The name is, of course, equally applicable to incision through the costal parietes. Partial "Hepatectomy" must now be included amongst operations on the liver, and will receive separate consideration.

The various operations will be most conveniently considered under the heads of the diseases.

Hepatic Abscess.

Anatomical Characters.—The fact that chiefly concerns the surgeon is, that the abscess is sometimes multiple. In the majority of cases, however, especially if of some duration, the abscess is single. There is always a tendency for abscesses, if multiple, to coalesce ; so that if one abscess is opened, and pressure be removed from the walls of its neighbour, there is a likelihood of the second bursting into the cavity of the first. In most the abscess is covered with healthy tissue, with uninflamed capsule, and an incision may have to be carried some distance through the healthy substance to reach it. If it is permitted to burst naturally, it is most frequently fatal. Rarely it bursts through the skin. Sometimes it bursts into the peritoneal cavity or pericardium, when it causes death. It may open into the pleura, when it is usually fatal. The most favourable openings are, into the bowel and into the lung ; though in both cases the prognosis is grave. In any case where free evacuation not into a dangerous site has taken place, there is a remarkable tendency for the abscess cavity to close up and cicatrise, while the liver readily regains the power of discharging its normal functions.

Diagnosis.—The diagnosis of abscess of the liver is sometimes very difficult, or even impracticable ; nevertheless, in most cases, especially with the help of the exploring needle, something like

çertainty may be arrived at. To begin with, we may have a history of residence in hot climates, and perhaps of malaria or dysentery. There may be a history of rigors. Sometimes also it would appear to be connected with operations on the rectum. There is the characteristic muddy complexion ; the harassed, anxious, restless expression ; the rapid pulse and the elevated temperature. The tongue is coated with white fur ; and there will be an irritable stomach, with vomiting. Locally there is pain and tenderness in the hepatic region, with enlargement, sometimes very considerable, of the organ itself. Occasionally, but not frequently, there is fluctuation. The presence of jaundice is rather against than in favour of abscess. When the abscess bursts into the lung, the chocolate - coloured expectoration is pathognomonic ; before it bursts, this sign may be got from exploratory puncture.

It is most liable to be confounded with empyema at the base of the right pleura, and it has been mistaken for pleurisy and pneumonia. I have seen a large abscess of the liver diagnosed as abscess of the kidney ; and the reverse is just possible. The nodular feel of a cancerous liver will usually distinguish it from a suppurating one ; and if no nodules exist on the surface, and the growth be behind, we can fall back upon the pyrexia that accompanies the latter. In hydatids also there is no pyrexia, very ittle constitutional disturbance, and but little, if any, pain : the hydatid fremitus is so rarely felt as to be of little value clinically.

SURGICAL TREATMENT.

For liver-abscess, as for other abscesses, there may be said to be no treatment that is not surgical. True, as in other cases, the abscess may become absorbed naturally ; but that is a result so rare, that no prudent man would wait for it. And we must not delay the necessary opening too long. If we wait for the abscess to point at a convenient spot, we may have waited too long, and the abscess may elect to point at an inconvenient spot. On similar grounds, we must not wait for the doubtful formation of adhesions to the body walls. They may never form

there; and if they did, it is doubtful if we could diagnose them. There is nothing for it but removal of the pent-up pus, as soon as an abscess is diagnosed.

The surgical measures available are:

(1) Aspiration.

(2) Puncture by trocar—leaving the cannula *in situ*.

(3) Opening by caustic or by thermo-cautery.

(4) Direct incision into the abscess through the body walls.

(5) Incision *à deux temps*, after the artificial formation of adhesions between the liver and abdominal walls.

(6) Incision, and drainage by abdominal section — Hepatotomy.

(1) The employment of the *aspirator* in hepatic abscess must be regarded rather in the light of a tentative and exploratory measure, than as a permanent cure. It is now used more extensively, perhaps, than published literature would lead us to expect. For clearing up a diagnosis, and giving temporary relief, the removal of quantities of pus from the liver by aspiration is of undoubted value, and not attended with much danger. Ransohoff's case of hepatotomy was aspirated without benefit, and he had to incise afterwards.* It may tell us where the collection mainly lies, and may even afford some light as to whether the abscess is single or multiple, but it can scarcely be expected at one operation to be curative. In a good few cases aspiration, repeated more than once, has been followed by cure. Ball, Maclean, Hammond, and others have had fairly good results from aspiration.†

In the use of the aspirator, its thorough cleansing with antiseptic lotions must be seen to. The needle may be introduced full of 1-20 carbolic lotion; the skin at the site of puncture must be thoroughly purified, as some of the epidermic scales may be carried into the abscess cavity on the point of the needle, and, if impure, be a cause of septic infection. The movements of the needle, following the movements of the liver (if it moves

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* *N. Y. Med. Rec.*, No. 22, 1882, p. 258.

† See Editorial *Annals of Surgery*, March, 1887.

with respiration), must not be checked, as thereby the liver tissue may be torn and permit escape of pus into the peritoneum.

(2) *Puncture by Trocar*—leaving the cannula to permit drainage—is a procedure by no means new. In 1842 Murray* advocated it; and since then it has been in quite general use, and is esteemed by many as the most favourable of all plans. An ordinary medium-size instrument is used; though De Castro† used a hollow trocar, with perforations corresponding to similar ones on the cannula. The cannula is left *in situ* for two or three days, when adhesions will have formed, and is then replaced by a drainage tube of some sort. The purifying of the trocar is to be carried out as carefully in this proceeding as in aspiration. Some antiseptic material, such as terebene with vaseline, or eucalyptus or salicylic cream, may be smeared over the trocar.

An indication in favour of the employment of the trocar would be, the tendency of the abscess to point, shown by œdema, or some redness and tenderness of the skin. Some danger may attend its use, however. In such a case as one of those operated upon by Knowsley Thornton, where the omentum, with large veins coursing through it, lay adherent on the surface of the liver, serious bleeding might arise. The risk of setting up inflammation of the liver substance by puncture with fine instruments is very small. Indeed, Trousseau used puncture by several needles, as a safe means of setting up inflammatory adhesion between the serous surfaces of the liver and the abdominal wall, as a preliminary to incision. But it must not be forgotten that puncture with trocar, after all, taps the abdominal cavity; and, being done in the dark, may cause serious injury to an abdominal organ other than the liver; and may even permit of the escape of pus into the abdominal cavity.

(3) Gradual opening by *caustic*, and by *thermo-cautery* applied to the abdominal wall over the tumour, are proceedings whereby a liver abscess may be opened. Both are slow and painful pro-

* *London Med. Gazette*, No. 38, p. 566.
† *Des abscès du foie des pays chauds et de leur traitement Chir.*, Paris, 1870.

ceedings, and are not likely to be brought into competition with other more rapid and less painful, while equally efficient, methods. Récamier* advocated the use of caustic potash applied to the abdominal wall for liver abscess. This process of gradual perforation by destructive chemical or thermic agents is more in vogue for the treatment of hydatids of the liver than for abscess.

(4) *Direct Incision* into the abscess through the abdominal or thoracic walls would be carried out only if there were signs of the abscess bursting of its own accord. Redness, tenderness, and some swelling at any part over a hepatic tumour which is probably suppurating, may be taken as an indication that the matter is working its way to the surface. In such cases there will be adhesions between the liver and the overlying peritoneum, and an opening may be made with safety.

It need scarcely be said that such a tendency to point is neither to be waited for nor encouraged. The chances of an abscess of the liver escaping towards the abdominal or thoracic parietes are, considering the amount of surface, at least not greater than the chances of its escaping through the diaphragm or into the peritoneum. And before signs of pointing appear the patient will have been reduced to a very low ebb.

After such incision, conducted antiseptically, a large drainage tube will be inserted. If the discharge continues sweet, there will be no need for syringing or irrigation of the cavity; if it is, or becomes, putrid, then frequent washings with some trustworthy antiseptic solution must be instituted.

(5) *Incision in two stages*—after the manner of Graves,† who made the incision only as far as the peritoneum; or of Begin (1830),‡ who went through the peritoneum—has much to recommend it. The operation in two stages is that favoured by Volkmann, and at the present day is known by his name. It is, in fact, an old application of the modern principle of creating

* Velpeau, *Méd. Opérat.*, 2nd Ed., iv., p. 19.
† *Dublin Hosp. Rep.*, May, 1827.   ‡ *Jour. Hebdom.*, 1830, i., p. 417.

adhesions between a hollow abdominal viscus which is to be opened and the parietes, when there is risk from escape of the contents of that viscus and not very great urgency for making the opening. In the case of hepatic abscess there is urgency, and consequently this double operation will not often commend itself.

In Graves's procedure, some lint or other material is pushed to the bottom of the wound in the parietes, setting up simple inflammation of the parietal peritoneum, which thus in a few days becomes adherent to the liver. Some uncertainty attaches to the plan by Begin, as it has been found that the liver does not always come up to, and lie in contact with, the wound in the parietes; and thus adhesions do not certainly form. There is always the risk in the operation which does not lay open the peritoneum that omentum or even bowel may lie directly under the opening and be wounded when the liver is incised. These objections are partly met by suturing the liver surface to the parietes, as recommended by Barwell.*

(6) *Hepatotomy*—the name usually given to direct incision through the liver tissue, after section of parietes—is the operation which most commends itself for hepatic abscess. With coeliotomy, the risks of wounding omentum or bowel are done away with : we see, and can control, the bleeding from the liver; the danger of escape of the abscess-contents into the peritoneum can be met and overcome, and if they do so escape they can be mopped up; while, lastly and not least important, a second abscess can be seen and opened, as has already been done in several cases.

To Lawson Tait belongs the chief merit of introducing and establishing the operation of hepatotomy. He had done the operation ten times when his work was published—nine times fo hydatids and once for abscess. All were successful. Thornton later published two cases,—one of suppurating hydatid cyst, done as a forlorn hope when the patient was profoundly septicæmic after five tappings, which failed; the other of hydatids, which was successful. It frequently happens that, after various surgical

* *Lancet*, Jan. 29th, 1887.

manœuvres, hydatid disease of the liver suppurates, and then may be considered and treated as an abscess. Bryant has in at least twelve such cases operated by direct incision, in each instance successfully; and other surgeons have had similar experiences. When such cysts suppurate, plentiful adhesions to the parietes will probably be found; and if, after careful dissection down to the cyst-wall, there are found adhesions to the parietes, the operation is simplified to a mere incision, for adhesions do away with the necessity for sutures. But in every case, unless we are certain to the contrary, we ought to act as if there were no adhesions.

A good many operations of hepatotomy for abscess have now been performed, the general mortality being about 40 per cent. Zancarol of Alexandria * records his experience of over 500 cases of liver abscess, on 145 of which he operated. In 115 cases of abscess in the right lobe, operation resulted in 57 deaths and 54 recoveries. Amongst the deaths were 32 cases of multiple abscess, which is said to be always fatal. In 30 operations for abscess in the left lobe he had 13 deaths, 8 of the deaths being cases of multiple abscess. Complete statistics, so far as I know, have not yet been published; individual cases and groups of cases show results more favourable than Zancarol's. Thus Dabney,† in a collection of 48 cases of hepatotomy for abscess, found 35 recoveries and 13 deaths. He quotes statistics of Ferron which included 47 cases of hepatotomy, in which there were 10 deaths, 5 being examples of multiple abscess. In 39 cases of simple abscess there was only one death; of 8 cases of multiple abscess, 5 terminated fatally.

The site for incision and drainage is selected over the point where the abscess lies nearest to the surface of the body. This will usually be somewhere in the epigastrium or right hypochondrium; but occasionally in abscess of the right lobe tending to point upwards the incision will have to be carried through the right thoracic wall, perhaps passing through the pleural cavity. In cases where the seat of the abscess is doubtful

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* *Ann. of Univ. Med. Sc.*, 1895, vol. iii., c. 2.

† *Amer. Journ. Med. Sc.*, Aug., 1892.

most surgeons employ the exploring needle; and when pus is found, leave the needle in to act as a guide to the making of the incision. When the abscess bulges in the epigastrium or the hypochondrium, the site for incision will be made over the most prominent part of the tumour, and, if there is no reason to the contrary, it will be longitudinal. A fairly long incision, from four (Tait) to five (Thornton) inches, will be necessary, to permit of the necessary intra-peritoneal manipulations. Should examination, after abdominal section, show that the liver is adherent to the parietes at any point, the opening should be made through the area of adhesion, even if this do not correspond with the opening in the parietes. Such an opening may be made with a trocar; it is made permanent by the insertion of a drainage tube. Should there be no adhesions, the opening is made directly into the liver. The liver tissue being recognised by its characteristic appearance, several soft flat sponges are placed round the spot selected for making the opening, to absorb any fluid that may escape. Then, if we think it necessary for more accurate diagnosis, or to relax the walls of the abscess cavity and permit of its being raised up more readily after incision, we may insert the largest needle of an aspirator, and withdraw some of the contents. A knife is then passed in along the side of the needle and the forefinger is made to follow the knife. While an assistant helps in maintaining, by pressure, exact coaptation of the parietes to the liver structure, the forefinger helps this by hooking up the abscess-wall. When all is ready, the knife is carried in along the forefinger, and the incision freely enlarged. Then the lips of the wound are quickly seized by two or more catch-forceps, and kept everted against the parietal wound by means of these. Bleeding may be arrested by a squeeze with pressure forceps, or, if this fail, by a continuous suture of not too fine catgut or silk. Probably the abscess will nearly empty itself readily enough; if it does not, a large rubber tube lying in carbolic lotion may be pinched at the end, and, when placed in the bottom of the cavity, will act as a siphon and suck out all the fluid. I have used with advantage such means for the removal of ascites and fluid from an ovarian cyst that was laid open, and have no doubt that it would answer here.

When the abscess is empty, the finger, carried round its walls, will examine for signs of a second abscess, which will be opened by pushing the finger into it, or by Lister's sinus forceps or by trocar, as seems best. The whole of the purulent material being removed, the cyst-walls are to be gently cleaned out with a soft sponge held by long forceps. Rough manipulation here might easily cause bleeding, either by breaking down the notoriously tender granulations of a hepatic abscess, or, if there is a membranous wall, by tearing it off the liver. While this is going on, an assistant has been gently, steadily and firmly keeping the liver in contact with the parietes. A sponge is now placed in the liver opening, and the sponges inserted at the beginning are removed, and the peritoneum is cleansed of any escaped or peritonitic fluid. If the pus is fœtid, an antiseptic may be applied to the walls of the emptied sac. Thornton uses iodine for this purpose.

When the sac has been emptied of its pus, and the peritoneal cavity is free of all fluids, the whole length of the incision in the liver is stitched to the margins of the wound in the parietes, and a large glass or rubber or celluloid drainage tube is inserted. If there is much discharge, it must be removed once or twice daily by syringing, so that it may be kept innocuous in case of absorption. Later on, as the cavity shrinks and its walls thicken, syringing may be employed less frequently, or even dropped. An abundance of absorbent antiseptic dressing will be necessary.

Zancarol uses the thermo-cautery both for section of the superficial parietes and for opening the abscess, except in cases of abscess of the left lobe when he uses the knife.

Where the abscess is situated in the higher portions of the right lobe, the opening must be made through an incision in the thoracic wall. Thornton* was, I think, the first to successfully treat a case of hepatic abscess by incision and drainage through the pleura. The patient had, fifteen months previously, been cured by aspiration of an abscess of the left lobe ; an abscess having appeared after two months in the right lobe, which was

* *Brit. Med. Journ.*, 1886, ii., p. 901.

not relieved by aspiration, Thornton decided to drain along the course of the aspirating needle. He cut out a lozenge-shaped piece of skin, carefully peeled the parietal and visceral pleuræ along small incisions, and sutured them to each other by a continuous suture, and so completely shut off the pleural cavity from the line of drainage. A track for the trainage-tube was made by incision along the side of the trocar. Healing took place without trouble. Hunsner and Schede operated in the same situation after resection of the ribs, and a good many similar operations by other surgeons have been recorded.

Hydatids of the Liver.

Anatomical Characters.
Diagnosis.
Surgical Treatment.
> *Electrolysis.*
> *Puncture.*
> *Puncture with Aspiration.*
> *Injection of Lethal Substances.*
> *Perforation by Caustic or Cautery.*
> *Operation in Two Stages.*
> *Hepatotomy.*

Anatomical Characters.—The liver echinococcus is usually single. When near the surface, it may stand out as a rounded fluctuating tumour, distending the abdomen in the hepatic region; when at a distance from the surface, it causes a more diffuse enlargement. The liver tissue is thinned out and expanded over it. Where there is no suppuration, there is little or no pain, and constitutional disturbance is slight or absent. It is exceedingly slow in growth, sometimes existing for ten or even twenty years without causing troublesome symptoms. Very frequently the echinococcus dies and shrivels up, leaving a curdy or chalky mass behind, enclosed in a cyst-wall. If it grows, there are almost no limits to the size it may attain. When the cyst grows at some distance from the surface, the liver tissue is spread evenly over it, and the symptoms may be nothing more than those of enlarged liver. Occurring near any of its surfaces, the cyst may cause symptoms by pressure on any of the neighbouring organs, or even by bursting into them. On the upper surface of the liver, it presses upwards the diaphragm, encroaching on the lung and causing dyspnœa, sometimes almost filling the right chest. Extending downwards, it may cause obstruction to the flow of bile, and jaundice, by pressing on the biliary ducts. By compressing the vena cava or portal vein, it may also induce

symptoms of venous obstruction. Rupture in any direction is always immediately dangerous, and may be ultimately fatal by causing infection with the parasites. Rupture into the vena cava is always fatal; into the peritoneum, usually immediately so, and still more frequently ultimately so. Suppuration is rare, except from surgical interference of some sort.

The more rare multilocular echinococcus is frequently associated with jaundice, and has a curious connection with tumour of the spleen.

Diagnosis.—In a comparatively young person, a slow-growing fluctuating enlargement of the liver that is unattended with pain, fever, or cachexia, is probably hydatid. Perhaps the conditions most closely simulating hydatids are, curiously enough, chronic hydro-nephrosis and ovarian cyst. Other diseases of the liver, such as cancer or abscess, are less likely to be mistaken for hydatids than the diseases mentioned. Such an experienced observer as Thornton operated on a case of hydatids of the liver, thinking it was ovarian disease; and it was not till he had gone some way through the operation that he knew for certain what he was dealing with. A hydatid cyst may fluctuate freely, may occupy nearly the whole abdomen, and give resonance in the flanks, just like an ovarian cyst; the absence of any palpable connection with the uterus might be explained by the existence of a long pedicle, while the continuity of its dulness with that of the liver may be explained by adhesions to the latter. From hydro-nephrosis of the right side, the diagnosis may be still more difficult. Many cases of hydro-nephrosis have been operated upon in the belief that they were ovarian cysts; and if echinococcus were more common than it is, perhaps hydro-nephrosis would just as frequently be confounded with hydatids of the liver. When the cyst exists on the upper surface of the liver, its diagnosis from pleurisy is exceedingly difficult. As Traube has pointed out, pain in the right scapula, as pointing to liver disease, may be the only symptom to guide us. In such cases, of course, the existence of fever and other well-known accompaniments of pleuritic effusion will be carefully looked for. An exploratory puncture will

almost, but not quite, certainly settle the diagnosis. Echino-coccus fluid is non-albuminous, contains a large amount of chloride of sodium, and is usually below 1.015 specific gravity. No other fluid of the body has these characters. The presence of hooklets in the fluids withdrawn, or of pieces of the laminated echinococcus membrane, is pathognomonic. When a hydatid cyst becomes inflamed, albumen may be found in the fluid, and then other difficulties are increased. When there is clear evidence of suppuration, we must operate without delay, and be content to make the diagnosis after the fluid has been withdrawn.

SURGICAL TREATMENT.

Though the call to treat a stationary or very slow-growing hydatid cyst may not be urgent, it must not be forgotten that a patient with a living echinococcus in the liver is in constant and increasing danger. The risks of suppuration or of bursting of the cyst, with the greater likelihood of death after operation on large tumours, make early treatment advisable.

The treatment of hydatids is entirely surgical, and resolves itself into destruction of the life of the parasite *in situ*, or evacuation of the contents of the cyst.

For causing the death of the parasite we have electrolysis; simple puncture; puncture, with removal of a small quantity of the fluid; and puncture, with injection of some chemical solution.

As electrolysis[*] has not yet shown better results than simple puncture, it is probable that it does good simply from the mechanical insertion of the needles. Acupuncture, again, has not been so successful as removal of a few ounces of the fluid by means of the aspirator. It has been found that this proceeding in some way kills the parasite, which then shrivels up and becomes innocuous. The operation is primarily a comparatively harmless one; though Bryant met with a death from puncture of a misplaced portal vein, probably letting the hydatid fluid get into the general circulation. There is, again, some risk of

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[*] For the mode of applying electrolysis, see Fagge and Durham's paper, *Med.-Chir. Trans.*, vol. xliv.

the fluid escaping into the peritoneal cavity through the opening left after puncture, and not a few have suppurated in consequence. Davies Thomas of Adelaide* collected 411 operations of puncture for hydatid of the liver: of these, 108 are described as reputed cures, 73 resulted in death, 68 were relieved, and others required subsequent radical operation. The death-rate of tapping is therefore about 19 per cent.—too high for a proceeding that is so uncertain in its results. The injection of some chemical fluid, such as iodine solution, has had fairly good results.

Each case must be a law for itself; but in an ordinary case of slow growth, the first treatment would probably be, to remove a few ounces of the fluid by aspiration, and carefully watch the course of events. If the cyst refills and goes on increasing, and more particularly if signs of suppuration appear, some plan of opening and emptying the cysts must be adopted. With this view, we have various old plans of operating by causing adhesions between the liver and parietes, and the more modern, and more perfect, one of direct hepatotomy by abdominal section.

For producing adhesions Simon† recommended and practised multiple puncture of the tumour through the parietes, and evacuation of the cyst-contents by incision, when adhesions would have formed after a few days. The first puncture is made diagnostic by being made with a hollow needle, and removing some of the contents for examination. Many successful cases, treated after this method, are recorded, and some failures. Volkmann has called attention to the danger of echinococci escaping from the puncture and infecting the peritoneum, and Hüter relates such a case where death resulted.

The plan of causing perforation by the application of Vienna paste, or caustic potash, or actual cautery, has found many adherents. At the Congress of the Society of German Surgeons in 1877, Bardeleben spoke of having treated no fewer than forty such cases by perforation with caustic, and with uniform success. He applied Vienna paste over an area of two fingers' breadth,

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* *Intercolonial Med. Cong. of Austral.*, 1889, p. 356.

† *Die Echinococcencysten der Nieren und des perirenalen Burdegeirebes.* Stuttgart, 1877.

which, in from six to nine days, perforated the abdominal wall, causing adhesions as it advanced, and then the cyst was opened with ease. Subsequent closure of the opening always took place without trouble. Davies Thomas* gives a mortality over 84 cases of about 34 per cent.

For causing adhesion to the parietes, Ranke recommends an incision through the peritoneum, and removal of two semilunar pieces of that membrane at the sides of the opening, to make the wound gape. After a week or so, when the adhesions are strong, the incision is made without an anæsthetic through the insensitive liver tissue, and the cyst evacuated. He speaks of four cases successfully treated in this manner, in his own and in Volkmann's clinic ; and other successful cases are recorded.

As a provision against the escape of the parasite into the peritoneal cavity, there can be no doubt of the validity of the plan of perforation by caustic. But it is too slow and too painful to have commended itself to the favour of English surgeons. Multiple puncture has been justly criticised as being possibly uncertain in its results ; sometimes causing multiple fine adhesions, useless for the end in view, or even causing no adhesions at all. To both proceedings the objection may be raised, that it is more or less a working in the dark, and that valuable information which an abdominal section might afford is withheld. The only objection that can be taken to the procedure of leaving the incised peritoneum to adhere over the liver is, that the delay has not the same strong reasons for it as other similar proceedings have, and that it may cause a loss of valuable time and possibly be a cause of inflammation in the cyst.

Hepatotomy, or incision and evacuation of the cyst as an immediate sequel to coeliotomy, is comparatively speaking, a new operation for hydatids of the liver. Lindemann, according to Davies Thomas, was the first, in 1871, to perform the operation ; but it was not premeditated. Sänger and Landau are also credited with operations on Lindemann's plan. Lawson Tait, in 1873, was the first who wittingly performed the

* *Loc. cit.*, p. 358.

operation for hydatids. Up to September, 1882, he had operated on nine cases, in all with successful result; and a good many other successful cases have, from time to time, been recorded. In skilful hands that can be trusted to successfully guard against escape of the fluid into the peritoneum, to quickly deal with possible hæmorrhage, and to accurately suture the liver wound to the parietal opening, the operation need not be attended with much risk.

The steps of the operation are essentially the same as in hepatotomy for abscess. There is frequently considerable tension inside a hydatid cyst, and its contents may be ejected with force when liberated. The whole of the contents must be gently and completely removed (Tait has used a gravy-spoon for this purpose), the cyst-walls united by continuous or other suture to the parietes, and a large drainage-tube inserted. Gardner of Adelaide,* whose large experience and commendable success entitle him to speak with authority, makes a complete removal of all cysts within the external envelope, the exit of the mother cyst being aided by dragging with suitable forceps. He now sutures the parietal peritoneum to the cyst-wall after exposing it and before opening it, leaving a space for operation. Through this space an aspirating needle is at once passed, and as much fluid as possible is drawn off; then the cyst is opened with a knife to the extent of one inch, and rapidly attached by stitches to the edge of the abdominal wound, not including the skin. In one case Thornton, with full confidence in the antiseptic method, used no drainage,† and had no cause to regret so doing. With most, however, the fear of hæmorrhage, or suppuration, or leakage through the liver wound, would weigh strongly as reasons for the insertion of a drainage-tube.

When the cyst has been thoroughly cleaned out, the forefinger is made to explore the walls, to see that there is no further cyst or even, as in a case of Pauly's, an abscess. Before closing the wound, most punctilious care must be taken over the toilet of the peritoneum; and, during this manipulation, a sponge will

* *Internat. Med. Cong. of Australia,* 1889, p. 348.
† *Med. Times and Gaz.,* Jan., 1883, p. 89.

be placed in the liver opening. Exactly similar precautions as to the coaptation of liver and parietes will be observed as in hepatotomy for abscess.

Bruce Clarke* advocates complete removal of the cyst-wall, and records four successful cases—one being of the kidney, however. The cyst is drawn to the surface, tapped, its walls are gradually pulled out through the parietal opening, and then incised. He then finds it an easy matter to separate and remove the cyst-wall from the ectocyst. When this has been done he sutures the cyst-opening to the edges of the abdominal wound and inserts a drain.

The *mortality* of direct hepatotomy is not high. Pilcher † has published tables of 64 operations—12 being done in two stages, and 53 (the incompatability of the figures is not explained) by the method at one operation. There were 8 deaths altogether, of which only 4 could be attributed to the operation—a mortality of about 7 per cent. Gardner in 20 operations had one death. Davies Thomas collected 68 cases of liver hydatids treated by hepatotomy in the manner described above: of these, 7 died; 3 of the deaths being from causes unconnected with the operation. His mortality statistics of various radical operations are worth quoting. Caustics give a mortality (omitting fractions) of 33 per cent.; canule-à-demeure, 26 per cent.; Simon's method, 48 per cent.; Volkmann's method, 19 per cent.; hepatotomy, 10 per cent. Bobrow‡ in 49 operations for liver hydatids, found that 21 by Lindemann's method had a 20 per cent. mortality, 28 by Volkmann's method had a 14 per cent. mortality.

The general opinion of surgeons as to the method of operating for hydatids of the liver now leans towards direct hepatotomy. It is admitted that simple cysts may be cured by tapping: but it is urged that not all cysts are simple, that the operation is not free from danger and may introduce grave subsequent risks. Other methods are no more safe than hepatotomy as regards immediate risk, and are inferior in respect of completeness of cure.

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* *Brit. Med. Journ.*, 1893, I., p. 689.

† *Annals of Surgery*, March, 1887.　　‡ *Centralbl. f. Chir.*, Aug. 18, 1894.

Partial Hepatectomy.

EXTIRPATION OF SOLID TUMOURS OF THE LIVER.

Portions of the liver have been removed for tumour growths, such as Adenoma, Gumma, and Sarcoma. In most of the cases the tumour has been an outgrowth or distinctly pedunculated, and the operation has been performed usually on an uncertain or incomplete diagnosis. The clinical features have been generally the presence of a rounded tumour attached to the liver, varying in size from that of a hen's egg to that of a man's fist, freely movable in the upper abdomen over the intestines, and associated with pain or distress. Complete diagnosis is made on exposure of the growth. In some there would seem to be formation of a distinct pedicle; most of these have proved to be adenomata or gummata. Here the operation is least difficult. In others pedunculation is non-existent and the growth or group of growths is buried in the liver proper. Such cases are usually malignant, and here the difficulties are greatest.

The *crux* of the operation is the checking of the bleeding, and much ingenuity has been shown in dealing with this. The chief plans adopted have been: constriction by the elastic ligature and extra-peritoneal treatment of the pedicle (Tricomi,* Schmidt†); ligature of individual vessels with tamponnade of the rawed surface with iodoform gauze (Von Bergmann ‡) and tamponnade combined with suturing of the gauze tampon on to the incised surface (Elsberg, Israel §). The thermo-cautery has been tried and found useless. The formation of flaps in the liver tissue and close suturing of the gap is possible in some cases, and has been successful. A suggestion of Ceccherelli that strips of whalebone be used as quill sutures to aid in the effectual compression of the bleeding surfaces is worthy of attention.

A study of the cases recorded makes it clear that no one

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* *Rev. de Chir.*, May, 1894.   † *Deutsche med. Woch.*, Feb. 22, 1893.

‡ Germ. Surg. Congress, 1893.

§ *Deutsche med. Woch.*, Aug. 23, 1894.

method is applicable to all cases, but that the surgeon should be armed with the fullest knowledge and the most complete surgical armamentarium. If the tumour is pedunculated, elastic ligation and extra-peritoneal treatment of the pedicle would probably be adopted. If there is no pedicle, or if it is too large to be so treated, an attempt to form flaps and closure of the gap by numerous animal sutures would probably be made. If this fails, the last resort would probably be tamponnage with gauze, supplemented, if necessary, by compression by sutures carried through the liver tissue, and possibly by quilled sutures. A combination of methods would probably be adopted in many cases.

The result of these operations as regards immediate mortality and subsequent health has been surprisingly good. Thus Bardeleben[*] relates a case of removal of sarcoma where there was no recurrence after two years. On the other hand, Israel's case of removal of sarcoma died in three months with recurrence; in this case the tumour was large and not pedunculated. One of the most remarkable of the successful cases was that of Tricomi,[†] where the whole of the left lobe was removed for adenoma as large as a man's fist. Naturally the best results may be expected in non-malignant and pedunculated growths. Diffused or deep-seated malignant tumours scarcely come within the range of practical surgery.

The results as regards mortality have been, as already remarked, surprisingly good. Israel[‡] states that there were only two deaths after 14 cases of extirpation of liver tumour. Keen[§] brings the list up to 20 with no additional deaths. Mayo Robson's successful case, the first in England, gives a total of 21 operations with two deaths.

* Germ. Surg. Congress, 1893.   † *Loc. cit.*
‡ *Deut. med. Zeit.*, July 9, 1894.
§ *Boston Med. and Surg. Journ.*, April 28, 1892.

Operations on the Gall-bladder and the Biliary Ducts.

History.
Conditions for which Operation is Performed.
  Cholelithiasis.
  Dropsy and Empyema of Gall-bladder.
  Obstruction in the Ductus Choledochus.
  Wounds and Perforations of the Gall-bladder.
Indications for Operation.
Sounding for Gall-stones.
Operations Described.
  Cholecystotomy.
  Cholecystectomy.
  Cholecystenterostomy.
  Choledochotomy.

The operations performed on the gall-bladder and the biliary ducts are nearly all for the removal of calculi or for the cure of morbid conditions induced by calculi. Hence terms referring to operations on calculi—lithotomy, lithotrity—are often employed in naming the operation. Usually, however, it is taken for granted that calculus is the reason for operation and the special name is omitted. The operations performed on the gall-bladder and the biliary ducts may be classified and named as follows:

1. Cholecystotomy, or incision of the walls of the gall-bladder for any purpose; cholecystostomy would apply to such cholecystotomies as result in the leaving of a fistula.

2. Cholecystectomy, or removal of the gall-bladder.

3. Cholecyst-enterostomy, or the formation of an artificial fistula between the gall-bladder and some part of the intestine.

4. Choledochotomy, or incision for removal of stone into any of the biliary ducts.

Cholelithotomy and cholelithotrity, referring to removal of stone by cutting or crushing, would be applicable to ducts or bladder. Cholecystendysis, cholecystorraphy and such names are sometimes used with evident significance.

History.—In 1618, according to Thudichum, Johannes Fabricius is said to have removed gall-stones from the gall-bladder of a living subject. Fabricius Hildanus* refers to this operation, but it is not clear that the operation was not done post mortem ; the only evidence of the subject being alive being the somewhat dubious expression " delineatio horum lapidum *ad vivum* facta."

To Petit† is undoubtedly due the merit of having founded the surgery of the gall-bladder. In 1733 he mooted his project: his most important papers appeared ten years subsequently. Petit's opinions were far in advance of his time. He discusses with great acumen the diagnosis of tumours of the gall-bladder, and the sequences of biliary retention. He recommends, besides the simple incision of an enlargement adhering to the peritoneum, two other operations: " l'une se sera dans le cas où la retention de la bile est portèe à l'extrême, et le malade en danger de mort : celle-ci est *la ponction ;* l'autre operation . . . c'est *la lithotomie,* je vieux dire l'extraction des pierres hors de la vésicule du fiel." His descriptions of these operations of puncture and lithotomy would almost pass muster in the literature of the advanced surgery of to-day. It may be affirmed that, till ten years ago, the surgery of the gall-bladder did not advance a step beyond where Petit left it ; on the contrary, it fell almost into oblivion.

Among English surgeons, with the exception of that shrewd surgeon Samuel Sharp, Petit's work was ignored or condemned. On the Continent, Morand (1757), Haller (1760 *circa*), Herlin, Blochs, and others, by observations and experiments, sought to advance Petit's labours. Bromfield, in 1773, wrote to condemn the operation. Morgagni, Chopart, Desault, and Walter, about the end of the eighteenth century, did valuable work in varying the methods, but scarcely in improving the results. Richter appeared in 1798 with a litho-triptor, and explained how fragments

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* *Observ. Chir.*

† *Mem. de l'Acad. Roy. de Chir.,* tome i., p. 163. Paris, 1743.

could be removed by washing : he also advised, in certain cases, the operation *à deux temps*, as described for hydatids of the liver.

In the nineteenth century little advance was made. Delpech, in 1816, rather decried the operation ; and Good, in 1825, spoke of it as being of doubtful value. In 1828 Sebastian described an operation whereby adhesion was secured between the gall-bladder and the peritoneum before opening the tumour—a suggestion modified by Graves of Dublin. In 1847 Dufresne recommended opening by caustic ; soon after Récamier advised the trocar ; and several other modifications were suggested.

Thudichum, in 1859, wrote with an insight which recalls the work of Petit. He recommended abdominal section, suturing of the unopened gall-bladder to the abdominal wound, and opening after several days.

In 1866 Luton introduced exploratory puncture, doing no harm ; and in his presence, Thomas, at the Hôtel-Dieu in Rheims, discovered a stone by this means. This procedure has been resuscitated in modern times.

The modern operation of cholecystotomy was first performed by Dr. Bobbs of Indianopolis in 1867.* He incised the gall-bladder, removed some fifty small calculi, and closed the incision by one suture. His patient recovered. Marion Sims† followed with an operation which, though unsuccessful, had a most important influence in advancing the surgery of the gall-bladder. Sims originated the name cholecystotomy ($\chi o\lambda\dot\eta$—bile, $\kappa\acute{v}\sigma\tau\iota s$—bladder, $\tau o\mu\dot\eta$—incision). In England, Tait of Birmingham and Robson of Leeds have been conspicuously successful over extensive series of operations.

In 1882 Langenbuch introduced the operation of cholecystectomy, or removal of the gall-bladder ; and Thiriar, Courvoisier, and others took it up favourably, but with no striking success. In a small and selected class of cases, the operation may be performed with advantage.

* *Trans. Indiana State Med. Soc.*, 1868, p. 68.
† *Brit. Med. Journ.*, 1878, i., 811.

The conditions which may give rise to a necessity for operation may be conveniently classified as follows : *

1. Cholelithiasis.
2. Dropsy and empyema of the gall-bladder.
3. Obstruction in the ductus choledochus.
4. Wounds and perforations of the gall-bladder.

Cholelithiasis.—The great majority of operations on the gall-bladder are performed for conditions arising out of the presence of gall-stones. Apart from the weakening influences of the recurrent agonies of biliary colic, there are certain real dangers to life to be apprehended. The effects of simple colic itself have been fatal. The stones may set up inflammation, suppuration, and even gangrene, in the bladder-walls. They may become wedged in the cystic duct, or pass into the hepatic duct (though in this situation they usually have come direct from the liver), or cause obstruction in the common duct. The effects of backward pressure are seen in cystic distension, and, where the hepatic or the common duct is blocked, in jaundice. Occasionally they perforate the bladder through an ulcerated area, either directly into the abdominal cavity, causing fatal peritonitis, or, after the formation of adhesions, into any of the hollow viscera or through the abdominal wall, forming biliary fistulæ. Parietal fistulæ are, fortunately, the most common. Fistulæ communicating with the stomach and the bowels are next in frequency. Sometimes the communication is extended between different portions of bowel, as the colon and duodenum. The urinary bladder has been perforated. Arteries may be ulcerated through—the pyloric, for instance. The diaphragm has been perforated, and stones have been found in the air-passages. It is stated by some that gall-stones are an exciting cause of cancer of the liver : it is certain that they are frequent concomitants.

A curious fact which has independently impressed Mayo

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* See Roth, " Zur Chirurgie der Gallenwege," Langenbeck's *Archiv.*,
Bd. xxxi., Heft. i.

Robson, myself, and one or two other surgeons is, that a distended gall-bladder associated with jaundice has always been found to have its origin in cancer. Robson has operated on three such cases; I have operated on two, and refrained from operating on two others. In cancer the jaundice is persistent, continuous, and steadily progressive; in cholelithiasis the jaundice is intermittent, or increases after paroxysms of biliary colic, with chills and fever.

The association of gall-stones and cancer (85 per cent. of cases of cancer in the liver have also calculi) is too common not to be causal. Which, however, is cause and which is effect it is not easy to say. It is probable that they may alternate causally. A growth in the gall-bladder may tend to cause stagnation of biliary fluids and so predispose to calculous formation; long-standing calculi may irritate the mucosa and so determine the growth of cancer.

In obstruction of the cystic duct, the changes are local. If the obstruction is in the common duct, the changes are general as well as local; there is dilatation of the biliary channels of the liver itself as well as of the gall-bladder, with the symptoms of obstructive jaundice. Changes take place in the accumulated bile, which are identical in the bile-channels and in the gall-bladder. The bile is first transformed into a yellowish-brown watery fluid, which becomes mixed with a mucoid secretion from the duct-walls. If the obstruction has existed for some weeks or months, the bile is replaced by a perfectly clear fluid containing flakes of mucus, but little or none of the proper constituents of bile,* which is all the more remarkable that the tissues generally may be saturated with it. In obstruction of the common duct, general cholæmia now supervenes. In obstruction of the cystic duct, matters may remain stationary after the bladder is distended, or the symptoms may become more urgent. Increase of tension may go on to inflammation, suppuration, or even ulceration and perforation.

Without obstruction, the presence of gall-stones may either set

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* It has been said that this fluid sometimes contains a ferment. My friend Mr. G. M. Smith, Professor of Physiology at the Bristol University College, fully tested a quantity of fluid removed by me in a case of cholecystotomy, and found no evidence of the presence of a ferment.

up no symptoms at all, or may cause any degree of inflammation from simple catarrh up to suppuration and necrosis. Accompanying the catarrh we sometimes find a low cellulitis of the outer coats, leading to subsequent thickening and contraction. But this cellulitis is sometimes of an acute nature, leading to great increase of size from thickening of the bladder-walls. One of Musser and Keen's cases, in which operation could not be completed, was probably of this sort.

Tait informs us that he has found in the majority of cases either a very few large stones or very many small ones. An examination of collections of gall-stones in museums, shows that biliary concretions in the gall-bladder generally show this peculiarity.

Cholelithiasis is essentially a disease which occurs in women over thirty who have borne children. Gall-stones are nearly five times more common in women than in men; the incidence of their occurrence increases from thirty on to sixty years of age; and from the fact that 90 per cent. of such women have borne children, child-bearing, or rather the anatomical changes associated with it, has been put down as a cause. The weight of this inference is, however, discounted to some extent by the fact that most women between thirty and sixty years of age have borne children. Stagnation of bile in the ducts or bladder is no doubt an important element in the causation, and this is promoted by fixation of the lower ribs by the use of stays, which has possibly its worst influence in abdomens which have had their parietes relaxed by pregnancy.

Dropsy and Empyema of the Gall-bladder.—In most cases these conditions are sequels of obstruction in the bile-ducts. The most common cause of obstruction is a gall-stone; but collections of parasites, such as liver-flukes, hydatids, or worms, have been found to cause blocking. Stricture following localized inflammation, and obstructive catarrh, are also reckoned as causes. Rarely the cause is external, arising from pressure by a new growth, springing from a neighbouring organ.

There is, practically, no limit to the amount of distension which

a dropsical gall-bladder will bear. The bladder-walls are nearly always thinned. Empyema does not usually attain to great dimensions : perforation is liable to occur when distension is excessive. In empyema, the walls are greatly thickened in some places ; at others, they may be thinned by stretching or ulceration. The changes which take place in retained bile, leading to dropsy, have already been described : the passage to suppuration is easily understood.

A curious condition occasionally found associated with distension of the gall-bladder is the dragging out of a piece of liver attached to the fundus of the gall-bladder to form a tongue-shaped covering to it. This occurs probably as a result of close adhesion of the fundus of the bladder to the liver margin ; the bladder, being fixed at both ends, when it gets enlarged pulls out a piece of liver tissue with it. Several cases of this sort have been recorded. One of the most remarkable occurred in my own practice. Here the gall-bladder, enormously dilated, was coiled upon itself so that the fundus, covered with a linguate piece of liver, crossed the middle line in the epigastrium. It contained two round calculi.*

Obstruction in the Common Duct.—This may be caused by foreign bodies in the duct, such as gall-stones, worms or hydatids ; by stricture in any part of its course ; or by compression from the outside by inflammatory exudations or new growths in neighbouring organs. Among these last must be reckoned tumours of the pancreas, duodenum, stomach, and kidney. The bladder may become distended to considerable dimensions, and the contents may undergo the changes already described.

Jaundice, passing into profound cholæmia, is to be expected, with its well-known train of symptoms. Few cases last more than six months before symptoms of cholæmia appear, and death usually supervenes within the year. One case is recorded by Murchison in which there was complete obstruction for six years.

* See *Clin. Sketches*, Lond., vol. i., 1895.

Wounds and Perforations of the Gall-bladder.—The gall-bladder may be wounded by cutting or piercing instruments; or it may be perforated by ulceration started by a foreign body in its cavity; or it may burst from over-distension. Bursting of an empyema is always fatal; escape of a foreign body with the bladder contents, though usually fatal in a very short time, has in a very few cases not been fatal for some weeks. Localised peritonitis is set up, which confines the extravasated contents in a suppurating cavity for a time. Simple extravasation of bile has usually been reckoned as certainly fatal. But the experiments of Schüppel, Boström, and others would seem to show that large quantities of bile may be absorbed by the peritoneum without causing much trouble; and certain recorded cases of wound of the gall-bladder show that a similar result may take place in the human subject. Paroisse records a case in which a ball remained for two years in the gall-bladder. Sabatier had a patient who lived seven years after wound of the gall-bladder by a sword-thrust: at the post-mortem examination, much fluid bile was found in the abdomen. But, in spite of these and other cases, the general experience is, that wounds of the gall-bladder, with extravasation of bile, are nearly always fatal. Sometimes, before death takes place, there is an enormous accumulation of bile in the abdomen. Thiersch successfully removed forty-seven pints of what appeared to be pure bile from the abdomen of a boy whose gall-bladder had been ruptured by a blow.

Diagnosis.—Cholelithiasis, in its simplest form, is diagnosed by recurrent attacks of hepatic colic, with or without enlargement of the gall-bladder, and not necessarily accompanied with jaundice. The symptoms of hepatic colic are well known. Paroxysmal attacks of pain in the epigastric and right hypochondriac regions, radiating towards the back and shoulders, often preceded by a rigor, frequently accompanied by vomiting, and always attended by profound constitutional disturbance, suggest the passage of gall-stones. The paroxysms, increasing in severity, may pass off suddenly in a few hours: rarely do they last more than one or two days. The liver is usually enlarged during the attack:

and occasionally it is possible to detect a distended gall-bladder. If jaundice is present, we may infer that there is occlusion of the common or the hepatic duct.

If there is permanent occlusion of any of the ducts, there may be distension of the gall-bladder. The physical characters of an enlarged gall-bladder are of importance. In all cases it will appear to have its origin in the right hypo-chondrium. When first discovered, such a tumour is usually about the size of the closed fist; but all dimensions are met with, even up to filling the abdominal cavity. Kocher operated successfully on a case in which the disease was supposed to be ovarian cyst; and Tait has had a similar experience. The line of enlargement is usually in a diagonal line from the normal situation of the gall-bladder towards the umbilicus. Mr. J. W. Taylor * has specially insisted on this point as an important aid in diagnosis. A dull note is usually given out over the whole tumour, but sometimes a resonant area is found at its junction with the liver. The shape of an enlarged gall-bladder has been described as cordate, or pyriform, or globular. According to the amount of tension and the thickness of its walls, the tumour may be hard and unyielding, or soft and semi-fluctuating. Its consistency is, however, not easily ascertained, on account of its tendency to slip backwards from the grasp. The tumour, if not of large dimensions, moves upwards and downwards with the liver during forced expiration and inspiration.

The conditions most likely to be mistaken for enlarged gall-bladder are, tumours and cysts of the right kidney, and movable kidney. Any solid growth of the kidney may be mistaken for an enlarged gall-bladder; but mistakes are most likely to arise in cases of cystic tumours, and especially of hydro-nephrosis. In these cases symptoms of functional disturbance of secretion of urine are to be diligently sought for. From movable kidney, the points of distinction refer specially to peculiarities in shape, consistence, and range of mobility, as proper to each. An important criterion is, the presence of resonant bowel overlying a movable kidney. Hydatid or other cysts of the peritoneum

* *Brit. Med. Journ.*, Jan. 31st and April 11th, 1885.

might be a possible source of confusion. A patient recently died in the Bristol Infirmary of aneurysm of the pyloric artery; for two months the diagnosis was enlargement of the gall-bladder. Acupuncture and aspiration are not recommended as aids to diagnosis.

Of jaundice as a factor in diagnosis, no more need be said than that its presence in a marked and persistent form indicates obstruction in the common or the hepatic duct. Though we might expect that obstruction in the common duct would be uniformly attended with cystic distension, and obstruction in the hepatic duct with cystic collapse, the clinical facts are by no means uniform in either direction. The detailed accompaniments of obstructive jaundice cannot properly be considered here. The presence of leucin and tyrosin in the urine, and diminished secretion of urea, may aid in diagnosis.

The diagnosis of wounds of the gall-bladder must be purely inferential, unless there is an escape of bile through a parietal wound. Abdominal shock, with a sensation of distress in the right hypochondrium and a history of traumatism in that region, followed by abdominal distension and perhaps by jaundice, suggest rupture of liver or gall-bladder, or both. The injury is a rare one. Perforation by a gall-stone, or rupture of an empyema, are diagnosed only through the help of previous history.

Indications for Operation.—In every case of wound or perforation of the gall-bladder, operation ought at once to be performed. Operation gives the only chance of recovery.

In every case of empyema of the gall-bladder operation is indicated. Aspiration is only a temporary measure, and it is by no means free from danger.

In every case of dropsy of the gall-bladder operation is indicated. Aspiration may do no harm, and it may detect the presence of stone. But it is useless towards the removal of the stone, and, generally, it has no beneficial effect on the disease.

In cases of cholelithiasis, the indications to operate must be guided by the effects produced by the disease. The dangerous sequences of gall-stones are: frequently recurring attacks of

hepatic colic, which wear out the patient's strength ; jaundice, proceeding to dangerous cholæmia ; and suppuration in the gall-bladder. The indication in each instance is strengthened by the presence of an enlarged gall-bladder.

No general rule can be laid down as to the weight of the indication arising from hepatic colic. After months or years of intense but intermittent suffering, many patients get well, and remain so. On the other hand, a patient's life may be rendered miserable, or his active existence as a bread-winner may be cut short, by persistently recurring attacks of hepatic colic. A time then comes when patient and surgeon both agree that it is proper to interfere. In all such cases the patient's desire must have great influence with the surgeon.

In cases of persistent obstructive jaundice, operation is at the same time indicated and contra-indicated. Cholæmia, not only as weakening and depressing the patient, but also as predisposing to bleeding, is an unfavourable element. In only seven of Musser and Keen's series of 35 cases of cholecystotomy was jaundice present,* and five of these cases died,—half of the whole mortality. That the jaundice had much to do with this excessive death-rate, there can be no dispute ; further experience has only too strongly confirmed this fact : this suggests early operation, before the patient's condition is lowered by cholæmia.

Where evidences of suppuration appear in cholelithiasis, operation is to be urged. Every day that passes brings increase of danger.

In cases of obstruction of the common or the hepatic duct, cholecystotomy may simply prevent death from cholæmia by permitting escape of the biliary poison. But for this condition a special operation of crushing the stone in the duct, or of removing it by cutting, is preferable.

In cases of obstruction of the cystic duct, operation in the majority of cases will not only relieve pain, and remove danger of suppuration in the gall-bladder, but will also, in all probability, bring about complete cure.

* *Amer. Journ. Med. Sc.*, October, 1884.

Mayo Robson, whose extensive experience and valuable work on the subject* give his opinions great weight, thus summarises the indications for operating in cholelithiasis:

"(1) In frequently recurring biliary colic without jaundice, with or without enlargement of the gall-bladder.

"(2) In enlargement of the gall-bladder without jaundice, even if unaccompanied by great pain.

"(3) In persistent jaundice ushered in by pain, and where recurring pains, with or without ague-like paroxysms, render it probable that the cause is gall-stones in the common duct.

"(4) In empyema of the gall-bladder.

"(5) In peritonitis starting in the right hypochondrium.

"(6) In abscess around the gall-bladder or bile ducts, whether in the liver or under or over it.

"(7) In some cases where, although the gall-stones may have passed, adhesions remain and prove a source of pain and illness.

"(8) In fistula, mucous or biliary.

"(9) In certain cases of jaundice, with distended gall-bladder dependent on some obstruction in the common duct; but in such cases the increased risk must be borne in mind, as malignant disease will probably be the cause of the obstruction."

The *mortality* in skilled hands is very small. If operation is performed before cholæmia supervenes, a death-rate of not more than five per cent. may be predicted. Of the 35 cases quoted in Musser and Keen's table,† ten died. Depage ‡ collected 78 operations; of these, six were done by immediate peritoneal closure: three died immediately from peritonitis, one had recurrence, and two recovered. In seventy-two, the gall-bladder was sutured to the abdominal wound: of these, eleven died—five from hæmorrhage and collapse, others from ordinary causes or accidents. Mayo Robson, in a brilliant series of over 100 cases, has almost no mortality where there is no jaundice; and in all cases a death-rate of only four per cent. Tait has

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* *On Gall-stones and their Treatment*, Lond., 1892, and *Brit. Med. Journ.*, April 28th, 1894.

† *Amer. Journ. Med. Sc.*, October, 1884.

‡ *Lancet*, Jan. 12th, 1889, and *Journ. de Méd.*, Brux., 1888, No. 24.

published 55 cases with three deaths. In 11 cholecystotomies I have had no death ; one patient with stone in the common duct and jaundice died of hæmorrhage.

Collapse with hæmorrhage would seem to be the most usual cause of death ; and this cause is most potent in cholæmic individuals. Jaundice, therefore, in all cases coming up for operation, must be regarded as a contra-indication ; and specially so if the jaundice be of long standing. Amongst the bad results, counting practically as failures, must be reckoned the considerable number, about one-third, in which biliary fistulæ have remained for months or years. This might often be avoided.

Sounding for Gall-stones with a probe passed through a hollow cannula inserted into the gall-bladder was proposed by Petit* in 1733 ; but was not put into practice till 1876, when Bartholow successfully used the method. In 1878 Brown† sounded gall-stones in this way. A similar purpose may be served by using the fine needle of an aspirator as a sound. Whittaker of Cincinnati, in conjunction with Ransohoff, in 1882,‡ employed this plan. Harley in 1884, § in ignorance of Whittaker's priority, practised sounding for gall-stones. These cases were successful in detecting the stone.

The proceeding is not free from risk. In Harley's case, after a short interval, enteritis and peritonitis set in, and killed the patient. In Keen's first case, not a little hæmorrhage and considerable local peritonitis followed the use of a hypodermic syringe. Unless there are very urgent reasons for doing so, few men would care to risk a patient's life for the sake of making a diagnosis. Urgency is great only when a patient's life, in imminent danger, can be saved by a very grave operation, and an error in diagnosis would be a catastrophe. And if we bear in mind the blind, groping nature of the proceeding, and the close contiguity of important organs and vessels, we must admit that the risks are scarcely less than those following extravasation of

* *Maladies Chir.*, i., 282.   † *Brit. Med. Journ.*, 1878, ii., 916.

‡ *New York Med. Rec.*, i., 1882, p. 568, and ii., 1882, p. 258.

§ *Med. Times and Gaz.*, May 17th, 1884.

bile or pus. Musser and Keen, though justly criticising the somewhat crude proceedings of Harley, and quoting the disastrous result of his own case to disprove his statement that the operation is both "easy and safe," still look upon exploratory puncture with favour, on account of the valuable information which it may supply.

I look upon the proceeding with no favour whatever. If the gall-bladder were considerably enlarged, if its walls were thick, and it lay in contiguity with the abdominal wall, puncture might be safe ; but we can very rarely be certain that these conditions are present. The positive detection of a stone in the bladder is a clinical fact of supreme importance ; but a failure to detect stone is, as more than one case has shown, no proof that it is not there. And it is not the presence of stone that justifies operation. A stone or stones in the gall-bladder may be perfectly harmless ; we have no right to meddle with them unless they produce serious discomfort or danger.

I am strongly of opinion, that in cases where it is clear that surgical interference of some sort is called for, the operation should in the first place be opening the abdomen ; then, exploration with the finger ; and then, cholecystotomy, if the operation is to be anything more than exploratory. Of course, where a suppurating gall-bladder is adherent to the abdominal wall, mere incision is all that is called for—provided the incision will permit of the withdrawal of stones.

Cholecystotomy.

Cholecystotomy is the name given to incision made into the gall-bladder after division of the parietes. It may be followed by removal of gall-stones—cholelithotomy; or by crushing of stones that are impacted and cannot be removed—cholelithotrity. In other cases it is simply of the nature of an evacuation of cystic or purulent fluids, followed usually by drainage.

The parietal incision is best made vertically over the most prominent part of the tumour, if there is one; and over the situation of the fundus of the gall-bladder, if there is not. The best landmark is the tip of the cartilage of the tenth rib: the fundus of the gall-bladder lies directly beneath it. Musser and Keen recommend that the incision be made parallel to the ribs; and various other lines of incision have been recommended. Czerny* recommends a rectangular incision, one limb being vertical and the other transverse, the fundus lying between them. I employ an incision following the direction of the fibres of the external oblique muscle, that is, directed from the fundus of the gall-bladder towards the umbilicus, with separation of the fibres of the internal oblique which run at right angles to the line of the incision. If the incision has to be enlarged, I would prefer to do so along the margins of the ribs, because thus abundant room is provided and the important fibres of the internal oblique are not divided to any extent. In cases where the rectus is broad and the abdomen is narrow the entrance may be made through that muscle: this is the best mode of entrance, for it divides no muscular fibres and so brings little risk of hernia.

The peritoneum, pinched up between two pairs of catch-forceps, is opened by slowly cutting through the elevated fold stretched between them. Through the opening the right fore-finger is inserted, and the bladder explored. If the bladder is much distended, and more particularly if it "fills the abdomen," such exploration is impossible (as it is unnecessary) until the

* *Deutsch. med. Woch.*, 23, 1892.

fluid has been drawn off. If the bladder is small, the presence of stones may be easily detected by touch. But sometimes, it would seem, we may meet with considerable difficulty in finding the bladder.

The opening is made in different ways, according as the bladder is collapsed, moderately full, or enormously distended.

If the tumour is very large, its contents may be at once evacuated by an ordinary cyst-trocar. During the evacuation, the cyst is gradually brought to the surface — and, if possible, a little way out of the wound—by forceps attached by the side of the trocar. But the cyst-wall should not be roughly dealt with by compression-forceps; as it must be left behind, we must be careful not to cause sloughing. If small catch-forceps are applied in the line of incision above and below the trocar opening, the chance of danger from injury is minimised by having the bruised area in the line of attachment to the parietes. This caution is all the more necessary in dealing with greatly distended gall-bladders, when, as is frequently the case, their walls are very thin. In every case flat sponges are suitably placed around the site of puncture, to absorb any fluid that may escape.

FIG. 215.

Hodder's Guarded Aspirating Needle. Half size.

If the cyst-wall is very tense from over-distension either by bile or by pus, it is best always to remove the fluid contents by the aspirator before making the large opening. An excellent needle, which may at the same time be converted into a blunt probe, is that invented by Hodder. (Fig. 215.) The needle is inserted as low down on the tumour surface as possible, because as the fluid is removed the cyst-wall contracts and draws the opening upwards. Any drops of fluid that exude by the side of the needle are at once mopped up. When the fluid is removed,

two small catch-forceps are placed, one at each side of the puncture; the cyst-wall is drawn forwards, and vertically divided by scissors to an extent sufficient to admit the forefinger.

Before this opening is made, it will be wise to place a sponge below the gall-bladder.

If the bladder is collapsed or but slightly distended, the opening may at once be made. The fundus is caught in a catch-forceps, and gently drawn to the surface. Below the bladder is placed a flat sponge, which keeps the bowels out of the way and absorbs any fluid that may escape. A second forceps is attached by the side of the first, and the raised fold between them divided by scissors to an extent sufficient to admit
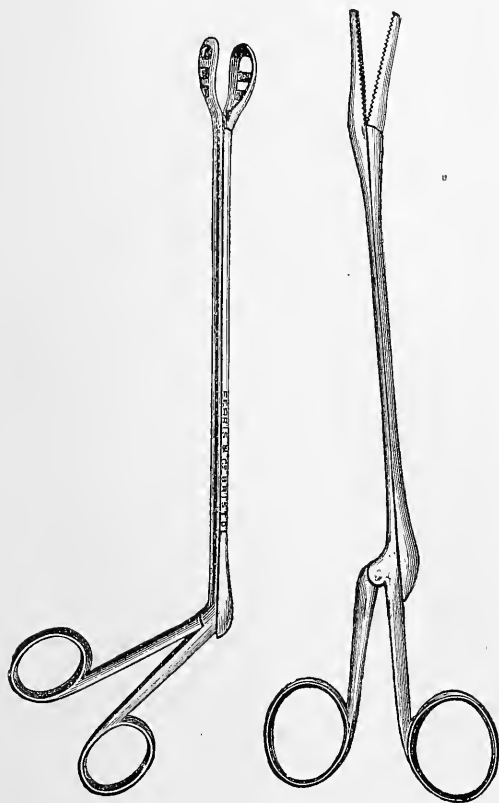
FIG. 216. FIG. 217.

Tait's Cholelithotomy Forceps. One-third size.

the finger. Any bleeding points are at once secured. The forceps placed on the edges of the wound are handed to an assistant, whose duty it is with gentleness to keep the opening in the bladder steadily forward in the abdominal opening; while he is also careful to mop up any fluid that may well up while the operator has his fingers or instruments inside the bladder.

The finger, inserted through the opening, feels for stones,

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measures their size, and tells how best they may be removed. For their removal, special scoops and forceps will be found very convenient. Small stones are scooped out; large ones are carefully extracted by forceps. All this is easy enough; but if a stone is impacted in the neck of the gall-bladder, and more particularly if it lies some way down the cystic duct, extraordinary difficulties may be met with. It must never be forgotten that the walls of the bladder and its ducts are thin, friable, and by no means distensile; that they may very easily be torn through; and that, if such an accident happens, the result, as creating a biliary fistula opening into the peritoneum, will be full of danger. Therefore, all manipulations upon impacted gall-stones must be carried out with extreme delicacy.

FIG. 218.

Anderson's Forceps for Removing Gall-stones.

Instruments may here be of assistance. For grasping the stone and removing it Tait's special forceps (Figs. 216 and 217) and Anderson's forceps (Fig. 218) with detachable blades should be at hand. Morison's scoop (Fig. 219), if it can be pushed beyond the stone, may succeed in removing it when everything else fails. A sharp needle with a handle, such as Lucas's stiletto for exploring the kidney, may be useful in breaking up the stone. I have thought that a very small and fine steel screw, like a cork-screw,

FIG. 219.

Morison's Cholelithotomy Scoop.

might be inserted into the stone while it is held firmly between the fingers inside the abdomen. Padded forceps for crushing the stone from the outside as suggested by Tait may also be in readiness.

If a stone impacted in the neck of the gall-bladder or in the beginning of the cystic duct cannot be removed by forceps, or by forceps combined with manipulation, it must be broken up *in situ*. This may be done in various ways. The alligator forceps may be used to break pieces off it ; such a proceeding must often result in injury to the mucous membrane and cause bleeding. If a needle in one hand can be pushed into the stone while the fingers of the other hand outside the bladder-wall steady it, it can easily be broken into several fragments by an adroit conjoined movement. These fragments may be reduced to powder by pressing them between the finger and thumb and rolling them about. Then they are washed out by irrigation. If these plans fail, crushing by padded forceps through the bladder-walls may be tried before adopting the last resort, namely, making an incision through the duct or bladder-walls and removing the stone. Such an incision is closed with difficulty and always with dubious success, for in the hands of the best surgeons choledochotomy too frequently eventuates in choledochostomy, and we have a biliary fistula discharging directly into the abdominal cavity. True, by means of gauze drainage a track can be made for the escaping fluid and diffuse peritonitis is avoided. But we should always try to avoid the possible risk of this by removing the calculus by means which do not necessitate the leaving of a sutured duct or bladder inside the cavity. Other devices of minor character will be employed by the resourceful surgeon.

Fig. 220.

Cholelithotomy Scoop.

During the manipulations there may be some bleeding from the mucous surfaces ; care must be taken that the blood does not escape into the general cavity. Before seeking to dislodge an impacted stone all fluid should be removed from the bladder.

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Musser and Keen invented and used a scoop of a special shape which was held under the bladder by an assistant, so as to catch any escaping fluid and prevent it from trickling backwards. Flat sponges serve the purpose equally well.

Suturing of the opening in the gall-bladder to the edges of the parietal wound is the next step. The sponge inside the abdomen is removed; and the surface of the bladder carefully cleansed. While the assistant steadily holds the opening in the bladder in the position where it is to be fixed, the surgeon passes the sutures. The best mode of suturing is by a continuous stitch perforating the bladder-walls along the edges of the incision, and taking a firm hold of the muscular and areolar tissues below the skin but not the skin itself. I soon found that when skin and mucous membrane were in contact there was a tendency for the fistula to become permanent, a disadvantage as great here as it is an advantage in such operations as gastrostomy. Therefore if we seek to have a fistula which will spontaneously contract and close, we must leave between the walls of the bladder and the skin a bare surface which will granulate freely. One continuous suture is employed which, while fixing the bladder wall to the parietes, will pull its orifice closely round the drainage-tube like a purse-string.

A rubber drainage-tube is placed in the bladder, and left protruding through the parietal opening. Rubber is better than an unyielding material, because of the movements during respiration. It is fixed in position by a stitch carried through the skin. If the tube fits the opening accurately, additional finish may be given to the operation by surrounding it with a sheet of rubber, as in drainage after ovariotomy; or, better still, even by carrying the tube itself to some distance from the wound, and placing it in a bottle which lies by the patient's side. By this latter plan I have been able to collect all the bile which escaped without any of it coming into contact with the wound.

An ordinary dressing of absorbent material is applied, and changed as frequently as may be necessary. At the end of a week the sutures are removed. The drainage-tube may be left longer if there is much discharge, or if the cavity it drains is

large and has not greatly diminished. A biliary fistula now remains, which will probably close in a few weeks if the ducts are pervious. If there remains an obstruction in the common duct, the whole of the bile will be discharged through the fistula, and attempts to close it will fail.

For the treatment of this condition if it depend on stone blocking the ducts, various resources may be adopted. If the stone can be felt by a probe, we may inject liquids which will soften or dissolve it. I used ether, and ether and turpentine, for this purpose in the Bristol Infirmary five years ago: the stone, far down in the cystic duct, certainly disappeared, but probably by means other than solution; and the fistula healed. Other fluids which have been suggested and used are a solution of tauro- cholate of soda; olive oil; and a five per cent. solution of sapo animalis or oleic acid. Ether and turpentine cause rather sharp pain and produce abundant secretion of mucus from the gall-bladder. If this fails a second operation, the nature of which will be dis- cussed presently, will have to be performed.

In cases where the gall-bladder is much shrunken so that it is impossible to bring it up to the parietes for suture we may either bring down the parietal peritoneum to it, or, as Robson has done, use the great omentum to shut out the general cavity, or perhaps best of all, employ the clever adaptations of his button which

Fig. 221.

Murphy's Adaptation of his Button for Drainage of a Shrivelled Gall-bladder.

Murphy devised for such a condition. One half of the button is a tube which comes out through the parietal incision; the other

half rests in the gall-bladder, the opened wall being grasped between them. The same result may less satisfactorily be secured by fixing the incised end of the gall-bladder around a rubber tube by means of a purse-string suture, and packing it around with strands of gauze taken through the parietal incision.

The plan of complete intra-peritoneal closure of the opening in the gall-bladder may be dismissed in a word. Bobbs, in his case, had a success, though he used only one suture. Gross, whose operation was a sequence to nephrectomy, cut out a piece of the bladder with the stone, and closed the opening by sutures. When his patient died from the effects of the major operation, the wound in the gall-bladder was found to be closed. These cases proved that intra-abdominal closure may be successful, and some surgeons continue to favour this proceeding, calling it by a somewhat gratuitous assumption of excellence the "ideal operation." It is not ideal in the sense of saving life; the total mortality is increased by two per cent. by this proceeding alone.

The walls of the gall-bladder when healthy are too thin to be satisfactorily sutured ; when thick they are inflamed and cannot be trusted to heal kindly. The risk of extravasation is far too great for the advantage to be secured, and therefore primary suture is not to be recommended. On these grounds the most experienced and the most successful operators, such as Tait, Robson, Keen, and Meredith are all against the proceeding.

The establishment of a temporary biliary fistula has certain advantages which are worth noting. If the bladder is dilated it permits it to retract and regain tone. If there has been any spastic contraction of the ducts, an additional exit for the bile is provided. If a stone has been overlooked (and this is always possible), the possibility of removing it still remains, and the risk from leaving it is not added to. Finally, it is always possible that calculi may form again in the bladder ; to be able to remove them through a simple incision through the old scar is a consideration of some weight. On these grounds I prefer cholecystotomy with drainage to the so-called "ideal operation" of cholecystendysis.

Cholecystectomy,

or removal of the gall-bladder, was proposed by Langenbuch, and carried out by him in 12 cases. Thiriar,* Courvoisier, and Tilmanns † have adopted the operation. In 22 cases collected by Depage there were only two deaths as a direct result of the operation. One death which should not be reckoned occurred in Thiriar's practice, in which cerebral tumour was the cause. Martig ‡ collected 87 operations of cholecystectomy, with 12 direct and 3 indirect deaths.

The idea is, to remove with the gall-bladder all future dangers, such as may arise from the presence of calculi in it. It is a fact that perfect health may co-exist with absence, atrophy, or obliteration of the gall-bladder. Some animals have no gall-bladder, and from others it may be removed without interfering with healthy existence.

Of Langenbuch's twelve operations, two died—one from ulceration of the bile-duct, caused by an undetected calculus. Seeing that Langenbuch speaks of obstruction in the common duct as a contra-indication, the result in his fatal case is a somewhat severe commentary on his operation. The mere fact that we cannot be certain in some cases that there is no stone left behind, is a strong objection to the operation. In a goodly proportion of cases of cholecystotomy, stones have appeared through the fistula after they had all been supposed to have been removed. It is not so much the death as the immediate cause of it that speaks against the operation. Not only does cholecystectomy not remove every nidus for biliary calculi, but it greatly adds to the risk, in cases of lodgment of stones in the ducts, by cutting off one avenue of escape. To seek to establish a place for cholecystectomy by decrying the advantages of cholecystotomy is futile. It is, however, justifiable to urge

* *Rev. de Chir.*, March, 1886.

† *Beilage zum Centralbl. f. Chir.*. 1887, xxv., p. 76.

‡ *Centralbl. f. Chir.*, April 14, 1894.

against the performance of the major operation the gratifying success of the minor proceeding.

The indications for operation given by Langenbuch are, dropsy, cholelithiasis, and empyema. These indications are probably too broad. I should limit the indications as follows; (1) where the bladder, containing one or more calculi, is so contracted that its fundus cannot be sutured to the parietes without tearing its walls; (2) where there has been perforation after ulceration and empyema, and the tissues are so thin or so much inflamed that they will not bear suturing; (3) where a simple mucous fistula remains, the cystic duct having become impervious.

The operation need not be difficult. Separation from the liver is begun at the fundus of the bladder and carried down to the cystic duct. The duct is divided between two ligatures, and the bladder removed. A suture passing through the outer coats will more thoroughly close the divided end of the duct. The incision will be at least an inch and a half longer than in cholecystotomy; if additional room is wanted, Courvoisier's plan of dividing transversely the muscles a little below the ribs may be adopted. If the bladder is intimately attached to the liver, a good deal of hæmorrhage may be expected; most of the bleeding may be checked by forci-pressure, but a few ligatures may be called for. During the operation the edge of the liver is pulled upwards by a retractor, and the area of operation is isolated by means of sponges.

If the removal of the bladder cannot, in whole or in part, be effected, ligature of the cystic duct has been suggested. It is difficult to see how this can be more beneficial than total occlusion of the duct from pathological causes. As the gall-bladder not only acts as a receptacle for bile, but also secretes a mucous fluid which probably contains a ferment, mere ligature of the duct does not seem to promise much benefit. Zelewicz* has had a successful case of ligature of the cystic duct after cholecystotomy.

Free bilateral incision of the gall-bladder, followed by suture and return to the cavity, has been recommended by Küster of Berlin, and carried out by him and Tillmanns of Leipzig. In

* *Centralbl. f. Chir.*, No. 13, 1888.

suppuration of the bladder, removal of redundant portions of tissue may be of advantage, and the same may be true of enormous cystic distensions; but it is difficult to see how the chances of recovery are improved by mere incision with subsequent suture.

Cholecystenterostomy.

By this operation is meant the establishment of a fistula between the gall-bladder and the intestine. The original operation of Winiwarter, already referred to, successfully established a communication between the gall-bladder and the colon. In this situation, the physiological effects of the biliary secretion were lost. Dr. Gaston of Atlanta, Georgia,* in a series of instructive experiments on dogs, showed how a communication might be established between the duodenum and the gall-bladder, thus preserving to the system whatever value the bile may have. Gaston speaks of his operation as duodeno-cholecystotomy. Some misconceptions and misdirected criticisms of Gaston's operation have appeared in various journals: to these he has given satisfactory answers.† A very valuable experimental and literary consideration of the operation has been contributed by Francesco Colzi of Florence.‡ Winiwarter's operation was colo-cholecystotomy: Gaston recommends duodeno-cholecystotomy; and this operation, where it is easily carried out, is theoretically the best. But fistula with the upper portion of the jejunum would be scarcely inferior to fistula with the duodenum; and fistula with any part of the jejunum, or even ileum, superior to fistula with the colon. The choice ought to be surgical as well as physiological: the operation may, therefore, be properly described as entero-cholecystostomy, or, as it is now usually known, cholecystenterostomy.

The *mortality* of the operation as performed in the manner to

* *Atlanta Med. and Surg. Journ.*, Sept. and Oct., 1882.
† *Med. and Surg. Reporter*, Phila., Sept. 12th, 1885.
‡ *Lo Sperimentale*, fasc. iv., v., 1886.

be described by the Murphy button is not high. At his last report * the operation has been performed 38 times with 1 death. A previous report mentioned 23 operations done by methods other than by the button with a 36 per cent. mortality. Mayo Robson had three successful operations by means of his small bone-bobbin. The evidence, therefore, in favour of the use of the Murphy button or similar appliance is overwhelming.

The *indications* for the operation given by Murphy† are:

(1) Obstruction to the common duct.

(2) Obstruction to the cystic duct where cholecystectomy is impracticable.

(3) Chronic cholecystitis, with thickening of the wall of the gall-bladder.

(4) Fistula through skin where patient is emaciating from loss of bile.

(5) Carcinoma of the pancreas in an early stage.

Mayo Robson ‡ gives the indications as follows: "Incurable biliary fistula due to insuperable occlusion of the common bile-duct, and obstructive jaundice due to the same cause."

Mayo Robson would therefore practically limit the operation to cases where there is insuperable obstruction in the common duct, and where the patient is either being poisoned by his own bile or starved for want of it. Most surgeons would probably agree with this view; but many would differ as to the meaning of the words "insuperable" applied to the obstruction. As an operation of despair, where a stone impacted in the duct presents so many difficulties in removal that the surgeon abandons it to its fate, it has been done and recommended. It need scarcely be said that such a proceeding, leaving the calculus behind possibly to breed further serious trouble, is not to be commended. As a temporary expedient intended to remain while the patient is recovering from cholæmia, it may with propriety be performed; but an attempt should be made to remove the stone either by crushing or by cutting later on. For cicatricial stenosis of the duct the anastomosis is of course permanent.

* *Lancet*, April 27th, 1895.   † *Lancet*, April 27th, 1895.
‡ *Op. cit.*, p. 155.

Certain criticisms have been made as to possible backward septic infection of the biliary channels outside and inside the liver from the bowel.   No example of such infection has yet been described.

The operation as performed with the aid of the Murphy button is simple and rapid.   The incision is the usual one for exposure of the gall-bladder.   Murphy specially recommends a vertical incision three inches long, two inches from the middle line starting from the edge of the ribs. The gall-bladder and the duodenum are drawn into the wound, the latter being cleared of its contents by pressure with the fingers and being clamped in any way desired.   " A needle with 15 inches of silk thread is inserted in the duodenum directly opposite its mesentery and at a point near the head of the pancreas.   A stitch is taken through the entire
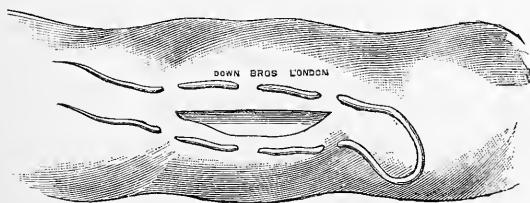
FIG. 222.

Insertion of Continuous Suture around Incision preparatory to insertion of Murphy's Button.   (MURPHY.)

wall of the bowel one-third of the length of the incision to be made.   The needle is again inserted one-third of the length of the incision from its outlet in a line with the first and brought out again, embracing the same amount of tissue as at first.   A loop 3 inches long is held here and the needle is inserted in a similar manner, making two stitches, parallel to the first in the reverse direction and one-eighth of an inch from it, coming out at a point near the original insertion of the needle (Fig. 222).   This forms a running thread which, when tightened, draws the incised end of the bowel within the cup of the button."   In the gall-bladder a running suture loop is similarly inserted.   An incision is now made in the intestine, two-thirds of the length of the

diameter of the button to be used ; the button is slipped in, and the suture drawn tight and tied.   After emptying the gall-bladder by aspiration, an incision of the same length as in the intestine is made in the same way between the suture lines, and the other half of the button inserted and the suture tied around the collar.
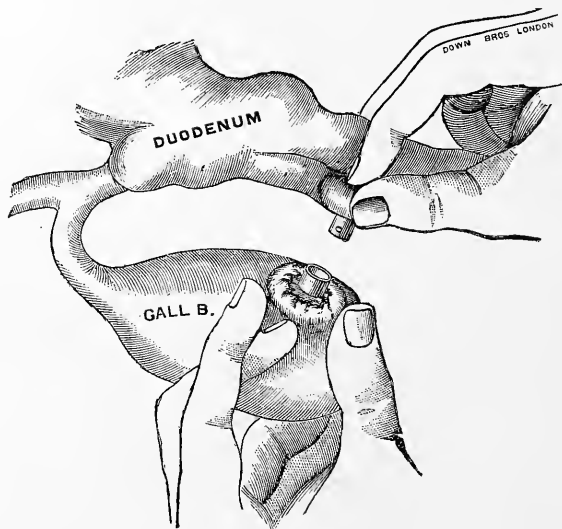
FIG. 223.

The Murphy Button in Cholecystenterostomy.   The two halves of the Button are inserted and about to be joined.

The serous surfaces to be approximated are scraped with the edge of a scalpel.   Then the two halves of the .button are approximated and joined in the manner already described under the Surgery of the Intestines.   The operation is now finished after cleansing of the intestines and suture of the parietal wound.

If Robson's method by decalcified bone-bobbin is used, the steps are the same as those already described in the intestinal section.   Besides the two puckering sutures grasping the button, an outside continuous suture should be applied.

Mayo Robson would make the junction to jejunum rather than to duodenum, for the reason that, on account of the depth and fixity

of the duodenum, the operation is not so easy. The jejunum is traced from its fixed point, and the first loop which approaches the gall-bladder is selected for approximation. There can be no doubt that fixation to jejunum would in most cases be easier than fixation to duodenum. As to late results, it is just possible that fixation of a naturally mobile piece of bowel to a fragile structure like the gall-bladder might beget disagreeable results from bladder and bowel aspects. But experience alone can settle such points.

If the operation is undertaken for incurable biliary fistula, the first steps of the operation will be to excise the fistulous tract through the parietes, and to close the opening into the gall-bladder. The closure must be very effectually done by a double row of carefully placed Lembert or other trustworthy sutures. The approximation is then carried out in the manner described by means of the Murphy button or the bone-bobbin.

If the surgeon prefers to make the junction by simple suture without any accessory apparatus, this may be carried out on the lines laid down for intestinal anastomosis. (*q.v.*)

Operations for Calculi in the Biliary Ducts.
Choledochotomy. Cholelithotrity.

Calculi in the biliary passages are found in only a small proportion of cases of cholelithiasis. In the common duct, with regard to which alone are statistics available, calculi are found, according to Courvoisier, in about four per cent. of all cases. Conrade, quoted by Fenger,* in 97 cases of chole-lithiasis found stone in the gall-bladder alone in 82 ; in the gall-bladder and the common duct in 10 ; and in the common duct alone in 5 cases.

A special importance from the symptomatic as well as from the operative point of view belongs to the presence of stone in the common duct as compared with the cystic duct. We are at the outset met with the grave fact of the presence of obstructive jaundice with its concomitant general unsuitability for operation, and the special superadded risk from hæmorrhage. The technical difficulties of the operation are also greatly increased on the common duct, and the chances of disaster from imperfection in method are high. Considering the diffi-culties and the risks, it is surprising and gratifying that such a considerable amount of success has already followed the operation of clearing the ducts.

According to Courvoisier,† whose exhaustive monograph brings the whole subject almost up to date, in two-thirds of the cases there is only one stone, and this is from 1 to 2 cm. in diameter. In one-third of the cases the stones are multiple, six being the largest number found. In 67 per cent. of the cases the stone is situated in the duodenal end of the duct, in 15 per cent. in the hepatic end, and in 18 per cent. in the middle portion. In about one-fourth of the cases the duct was dilated, in a few it had become cystic and the stone was movable or floating. Fenger has given most minute and thorough study

* *Amer. Journ. Med. Sc.*, Feb. and Mar., 1896.
† *Beiträge z. Pathologie und Chirurgie der Gallenwege*, Leipzig, 1890.

to the whole subject, and is of opinion that the stones are more often floating in a cystic dilatation of the duct than is generally supposed. He quotes six cases, on five of which he operated, and gives an elaborate description of each case. It is possible this may be one of those curious coincidences or sequences of cases which we are all familiar with. Thus I have personal knowledge of only six cases of stone in the common duct ; all were impacted and immovable inside a closely-enveloping duct. Two of these I operated upon, two are in museums, the other two were found in the hospital post-mortem room. Still I believe that the occurrence of dilatation of the duct will be found more common than has been supposed, and that the ball-valve action of the mobile stone described by Fenger as found in his cases is a fact of real importance.

One point which, pathologically, could scarcely have been expected, and which is of great value in diagnosis, must specially be noted: that is, that not only is the gall-bladder not dilated, but actually in most cases it is shrivelled and atrophic. In cancerous obstruction the reverse is the case. Fenger thinks the atrophy is easily explained by the ball-valve action of a floating stone at the end of the cystic duct. Courvoisier puts it down to a chole-cystitis set up by the stone when in the gall-bladder, and resulting in contraction of the bladder-walls. Neither explanation seems to me to be entirely satisfactory. In the kidney ball-valve action of a stone in the pelvis leads to hydro-nephrosis, and complete blocking to atrophy of the gland and collapse of its pelvis. Whatever be the cause, there is no doubt as to the fact, and it is of supreme importance both in diagnosis and in treatment. If the gall-bladder were dilated, or even if it were not shrivelled, in a case of jaundice from blocking of the common duct, we might in some cases gladly welcome the alternative of cholecystenterostomy for choledochotomy. In most cases, however, this alternative would be more difficult than the prime proposal, and the actual result might be disappointing from the cystic duct not being clear.

Only about half of all the cases of obstruction in the common duct are due to stone. Of 35 cases of operation for obstruction

in the common duct Courvoisier found that 18 were due to causes not connected with stone, such as tumour and stricture. In 13 of the 17 stone cases the gall-bladder was atrophic, in 16 of the 18 non-calculous cases the gall-bladder was dilated.

Symptoms.—Physical signs relating to the gall-bladder are absent, as it is not only not dilated but in most cases shrivelled. There may be enlargement of the liver, but this is by no means constant. The most important symptom is jaundice. The jaundice is rarely continuous, but intermits or remits, and is associated with attacks of hepatic colic. An attack of severe colic with intense jaundice usually means the passage of a stone through the common duct into the duodenum, and indicates general cholelithiasis. Several mild attacks of colic with slight icterus occurring frequently rather indicates stone in the common duct, and in Fenger's opinion a mobile stone producing ball-valve action. Deep and continuous jaundice lasting over long periods, perhaps for years, is against calculus, and points to other forms of occlusion and specially to tumour.

The pain in cases of stone in the common duct is seldom in the region of the gall-bladder, but rather in the epigastrium or deep in the lumbar and hypochondriac regions. Sharp attacks of pain which suddenly disappear and frequently recur suggest mobile stone. Certain postures are sometimes found by experience to give relief. Vomiting is an uncertain but not unfrequent concomitant: it often gives relief to the pain, being supposed to be associated with relief to the spasm of the muscle in the duct. There is some elevation of temperature during the attacks; this, the so-called biliary fever, is of little diagnostic value. Cholæmia is always associated with loss of weight, sometimes with extreme emaciation.

In preparation for the operation in cholæmic cases Mayo Robson speaks favourably of the administration of chloride of calcium, as preventive of hæmorrhage. He advises its being given in 15-grain doses every four hours for two days before operation.

The operation to be described is choledochotomy ; or chole-docholithotomy as first deliberately planned and performed after diagnosis of stone in the common duct by Courvoisier in the beginning of 1890. Stones had been removed from the common duct before this ; in 1889 I myself by a combination of cutting and crushing had done so ; but the credit of introducing the elaborated operation belongs chiefly to Courvoisier.

In competition with the operation of cutting there is the operation of crushing. Now this may often be easily done between the finger and thumb through the walls of the duct, and if we could be certain that the débris would be washed away it would be the best operation of all. Fenger condemns it as it "leaves débris, some of which may remain in a pouch in the duct, increase in size, and as the stone is always a bacterial depôt, may cause inflammation of the wall or even cholangitis." If it were possible to wash out the fragments by aspiration as in litholapaxy, or even after incision of the duodenal wall (as done by McBurney) through the duct itself as it enters the duodenum, I think the operation of crushing, by avoiding the necessity of making a large wound in the duct, would be the best. In a second case of my own, operated upon in the Bristol Infirmary in 1894, a large incision was made over an impacted stone over half an inch in diameter ; it fel to pieces on being caught in forceps, and I greatly regret that I did not crush it, for at death (from intra-abdominal hæmorrhage on the fourth day) the duct was found to be quite patulous towards the duodenum.

In competition with choledochotomy is cholecystenterostomy, which is not a cure properly speaking, but a make-shift ; but which may, in certain cases, be done to cure the patient of cholæmia as a preliminary to the radical proceeding. Un-fortunately the gall-bladder is nearly always collapsed and there is no certainty that the cystic duct is patent. In cases of tumour where the gall-bladder is often dilated, cholecysten-terostomy is probably the best operation to select. In two cases

where the stone was impacted in the diverticulum of Vater an incision was made through the duodenal wall to reach it.

The parietal incision must be a free one, as ample space is essential. Either one long vertical incision through the outer fibres of the rectus, or an angular incision one limb of which skirts the rib-margin and the other follows the fibres of the external oblique, should be selected. With either of these incisions ventral hernia is not likely to take place, as few or no muscular fibres are divided transversely.

We must expect, on entering the abdomen, to find general matting together of organs in the region of the gall-bladder; and the separation or division of these must be done with care and deliberation. The gall-bladder, often small and shrivelled, is first localised; and the surgeon works downward from it, keeping close to the liver. The orifice of the foramen of Winslow is felt for; the forefinger is inserted, and between it and the thumb the anterior border of it in which lies the duct is palpated between the liver and the duodenum. A large stone will easily be felt; a small stone or a floating stone may be felt with the greatest difficulty, or, as has several times happened in the hands of highly-skilled surgeons, may not be felt at all. If the stone is mobile, and it is pushed towards the liver, it may slip into the hepatic duct, when it is not easily returned.

When the stone has been felt and located, preparations are made for its removal.

The field of operation is firstly as far as possible isolated by flat sponges laid between intestines and liver, one being tucked well under the liver. These are watched and kept in position by the fingers of one hand of an assistant. The liver margin is pulled upwards, so as to make the organ rotate and expose its under surface as freely as possible. The assistant at the same time sees that the margins of the parietal wound are kept as widely apart as possible. If the parietes are muscular, a Maunsell's self-retaining retractor may be found useful. A good light is essential: an electric lamp and reflector should be in readiness.

The stone being steadied in the duct, an incision is made,

directly over it in the direction of the duct, and the stone is either pressed or scooped out. Bile usually flows out of the incision. In movable or floating stone, Fenger advises that the stone be pushed towards the duodenum and that the incision in the duct be made at its duodenal end, because then there is no chance of wounding the vena portæ.

The stone being removed, the duct should be probed upwards and downwards to feel for another possible stone or stones, and to see that the passages are clear. If the duct is greatly dilated, the little finger may be inserted to explore.

The difficult part of the operation, the closure of the common duct, is now undertaken. For insertion of the sutures, Mayo Robson recommends the use of a small rectangular cleft-palate needle. Other surgeons have used small curved smooth needles held in a needle holder. A double row of sutures is placed; the inner row passing through the external walls of the duct but not penetrating the mucosa, the outer row penetrating the peritoneal covering and picking up the outer coats after Lembert's method. The sutures are not tied till all are inserted, the long ends being employed to help in pulling forward and steadying the incision during the insertion of the stitches. A continuous re-inforcing suture may be placed at any weak point. Imperfect suturing may be proved by the escape of bile after the duct is liberated.

Drainage is always advisable. The best drainage would probably be got by Morison's method, through a stab-incision made below the kidney. Fenger recommends a rubber drain passed down to the wound in the duct, and gauze drains inserted, one above and the other below the drainage-tube. The parietal wound is closed in the usual way.

The after-treatment needs no special description.

Section XI.

OPERATIONS ON THE SPLEEN.

SUMMARY.

OPERATIONS ON THE SPLEEN.

THE operations performed on the spleen are Splenotomy, or incision into the organ for the evacuation of fluid ; Splenectomy, or removal of the spleen ; and Splenopexy, or fixation of a movable spleen.

SURGICAL ANATOMY.

The spleen, lying in the left hypochondriac region between the cardiac end of the stomach and the under surface of the diaphragm, is roughly moulded to fit the space in which it lies ; being concave on the stomachic aspect and convex on the diaphragmatic. On the concave inner surface, nearer to the posterior than the anterior border, is the vertical groove of the

hilum, pierced by apertures for vessels and nerves. The perito-
neum which invests the spleen is reflected at the hilum to enclose
the splenic vessels and nerves and the vasa brevia, and is known
as the gastro-splenic omentum. Surgically, this is the pedicle of
the spleen. (Fig.
223.) Between the
upper end of the
spleen and the
diaphragm passes
another double peri-
toneal layer known
as the suspensory
ligament of the
spleen. The exter-
nal surface of the
spleen, in contact
with the diaphragm,
is described as lying
in contact with the
ninth, tenth, and
eleventh ribs. The
internal surface, in
its anterior portions,
is in relation with
the cardia of the
stomach — behind,
with the left crus of
the diaphragm and
the left supra-renal
capsule; and below,
with the tail of the
pancreas. Its rela-

FIG. 223.   (WEISSE.)

*Drawing to show the Vessels in the Hilum of
the Spleen.*

1, 2. Vessels penetrating the Spleen at the Superior, and
4, the Inferior Extremities of the Hilum. 3, 5, 7. Gastric
Branches — Vasa Brevia. 6. Gastro-epiploica Sinistra.
Anterior Border to right, Superior Border above. Artery
above, Vein below.

tions with the stomach are liable to be disturbed by the movements
of that organ. As to the margin of the spleen: at the top, where
the suspensory ligament is given off, it is blunt and rounded; the
lower extremity is pointed, and normally lies over the junction of
the transverse with the descending colon: the posterior margin is

broad and rounded, and is connected with the left kidney by loose areolar fibres. The average dimensions of the spleen in the adult are: five inches in length, three or four in breadth, and from an inch to an inch and a half in thickness. Its weight is about seven ounces.

The structures in the gastro-splenic omentum, venous and arterial, which go to form the pedicle in splenectomy are of importance. The splenic artery, the largest branch of the cœliac axis, pursues a tortuous course behind the upper border of the pancreas from the aorta to the spleen. In its course it gives off small branches to the pancreas; near its termination it gives off the gastro-epiploica sinistra; and it finally breaks up into a number of branches near the hilum, most of which enter it, but a few of which—the vasa brevia—turn backwards to the stomach. The vasa brevia, from five to seven in number, issue partly from the trunk and partly from the branches of the splenic artery. If deligation is made close to the spleen, they may escape. The terminal branches are five, six, or more in number, and vary greatly in length and size. If the branches are short, and they enter the spleen over a considerable area, it would be impossible to include all of them in one or even in two ligatures.

The splenic vein is a very large vessel, returning blood, not only from the spleen and the pancreas, but also from the duodenum, a great part of the stomach and omentum, the descending colon, and part of the rectum. Its splenic branches correspond to those of the artery; the vein itself lies behind the pancreas, below the artery.

But little padding of fatty or areolar tissue surrounds the splenic vessels at the hilum. As it would usually be unsafe to include all the splenic branches in one ligature, it is fortunate that they may readily be isolated and ligatured separately.

Splenotomy.

This operation, done for abscess, may be dismissed in very few words. According to Nolen,* only five cases of recovery after

* Abstr. in *Brit. Med. Journ.*, April 19th, 1894.

operation for abscess on the spleen are recorded. To these might be added a sixth case in the service of a colleague at the Bristol Infirmary, and a seventh by Sendler.*

The abscess is usually found either pointing or adherent to the parietes, and the operation simply consists of evacuation and drainage. Occasionally sloughs of splenic tissue are found in the abscess sac. The diagnosis is not usually accurately made till the operation.

Splenectomy.

History.
Conditions for which Operation Performed.
Mortality and Indications.
Operation Described.

History.—The practice of removing the spleen is probably of some antiquity. It was done for purposes sufficiently vague, being supposed to improve the wind of the individual (as in the Texan runners), or to ameliorate his moral nature. Dionis, in his second demonstration of surgical operations (1733), speaks of a class or sect of surgeons which sprang into notoriety about 1700 from their operations of removing the milt or spleen—" unmilting " the proceeding was called. He does not spare them : " They looked on this part as useless and noxious, because (perhaps) unacquainted with its uses; and, in pursuit of this opinion, they prescribe the making an incision in the left hypochondrium, through which they take out the milt, and after having made a ligature of the vessels, boldly cut it off. This operation being performed on some dogs which did not thereupon die on the spot, they thence deduced and proclaimed the advantages which would accrue to mankind by it. . . . No longer mention is made of these cruel operations, which, owing their existence to some crude brains, found a sepulture in that of their inventors."

For prolapse of the spleen through a parietal wound splen-

* *Amer. Journ. Med. Sc.*, March, 1894.

ectomy was performed more than 200 years ago. Such an operation was that of Matthias, performed in 1678 :* and a few others are on record.†

Many experiments have been made on the lower animals by removing the spleen. In comparatively recent times, Blundell operated at least seven times on rabbits; two recovering permanently, and two temporarily. The whole subject has been experimentally gone into, with all the aids of modern science, by numerous physiologists and surgeons, and notably by Tizzoni, Mosler,‡ Zesas, § and Winogradoff. || These experiments prove that the spleen is not essential to the life of animals; and that if it is removed, its functions are taken up by vicarious lymphatic organs which increase in size, and by bone-marrow.

For disease, the first operation, according to Collier,¶ was performed by Zaccarelli in 1549, and was successful. The second operation, by Ferrerius in 1711, seems to have been the removal of a rudimentary spleen from an abscess tending to point ; it was also successful. Both these operations have been discredited. Quittenbaum in 1826, and Küchler in 1855, each removed an enlarged spleen ; the patients in each case dying in a few hours, of hæmorrhage. Spencer Wells operated for simple hypertrophy in 1865; his patient lived six days, and died either of thrombosis or of blood-poisoning—possibly of both. Péan in 1867, operating for enlarged and cystic spleen, had the first success of modern times: from his case we may date the introduction of splenectomy into modern surgery.

Conditions for which Splenectomy may be Performed.—Nearly all authorities are agreed that the extirpation of leucocythæmic spleen is an unjustifiable operation. Therefore, although the operation has been performed some twenty times, leucocythæmic enlarge-

* See Simon, *Die Extirpation der Milz am Menschen. Giessen.*, 1857.

† See Morris, *Internat. Syst. of Surg.*, vol. v., "Injuries and Diseases of the Abdomen."

‡ *Deutsch. med. Woch.*, 1884, No. 22. § Langenbeck's *Archiv.*, bd. xxviii., p. 815.

|| *Revue de Chir.*, 1885, p. 318 ; quoted from *Vratch*, 1883, Nos. 6 and 7.

¶ *Lancet*, 1882, i., p. 219.

ment is excluded from the conditions justifying operation. The following conditions remain:

(1) Injury or Prolapse.
(2) Certain cases of movable spleen.
(3) Simple hypertrophy, with or without cirrhosis.
(4) Sarcoma or lympho-sarcoma in the early stages.
(5) Cysts.
(6) Hydatid disease.

In the case of abscess, as well as of cysts, simple and hydatid, splenotomy, or incision of the spleen with suture of the wound to the parietes and drainage, should first be instituted. The treatment is carried out on exactly the same lines as for similar diseases of the liver or kidney, and need not be again detailed. Should splenotomy fail to cure, splenectomy may be indicated. Splenic abscess becomes early adherent to the parietes, and its treatment may be nothing more than incision and drainage. From such an abscess I have seen a piece of splenic tissue, as large as an orange, removed as a slough.

Wounds of the spleen can only be inferred with a presumption of certainty from the site of the injury and the presence of abdominal hæmorrhage. Later on, peritonitis, splenitis, and abscess may supervene, and induce symptoms calling for abdominal section, after which the condition is diagnosed with certainty. In such cases, the state of the patient is the indication to operate ; splenic wounds are by no means always fatal. Prolapse of the spleen through a parietal wound is easily diagnosed : in certain cases, the organ may be returned ; in others, only the protruding part need be removed.

Movable spleen, according to Engel,* is associated with pregnancy, depending on causes similar to those assigned by Landau to movable kidney. It is not free from danger to life. Reported cases show that a movable spleen tends to fall into the left iliac fossa ; that the organ is enlarged ; that its pedicle may become twisted, causing occlusion of the vessels ; and that it has a tendency to contract adhesions in its abnormal situation, and there undergo degenerative changes, or even gangrene.

* Centralbl. f. Gynäk., 1886, V.

Serious symptoms may be caused by dragging on the stomach through the gastro-splenic ligament. The operation of splenopexy, to be described, would now be considered preferable to splenectomy for such a condition.

Simple hypertrophy, with and without cirrhosis, has, in at least fourteen cases, been given as the reason for removal. It is difficult from the histories to estimate the influence of malarial disease in causing the enlargement for which operation was performed. The diagnosis is simply that of enlarged spleen, already described : in most cases, however, the operation was performed in the belief that the disease was something else.

Billroth* successfully removed the spleen for lympho-sar-coma. The tumour had existed for seven years : there was no leukæmia. It would be impossible in the early stages to diagnose malignant disease from simple enlargement. When the disease is so far advanced as to cause adhesions to neighbouring organs, the operation is unjustifiable. Indeed, from what we know of the behaviour of malignant disease of the spleen, we should infer that the operation was only very exceptionally admissible.

Considering the rarity of cysts of the spleen, it is somewhat remarkable that the organ should have been three times removed for that disease. All the operations were successful. Thornton's first operation—the first successful one in England—was for splenic cyst. The diagnosis cannot with certainty be made from renal cyst. Puncture, or incision with drainage, might be tried before removing the organ. As, however, the cystic disease is usually associated with hypertrophy of the splenic tissue, it is probable that the cyst-formation is only part of a more general disease. In none of the operations was the condition diagnosed till the abdominal cavity was entered.

For hydatid disease, puncture has been successfully performed by Wilde,† and probably by others. Koeberlé has extirpated the organ for hydatid disease followed by a sanious discharge. The diagnosis must always be uncertain.

Appreciation and Mortality. Indications and Contra-indications.— Collier's elaborate tables comprise 29 cases of splenectomy ; 13

* *Lancet*, June 7th, 1884. † *Deutsche Archiv.*, viii., 116.

being for diseases not associated with leucocythæmia—of these 8 recovered; 16 for leucocythæmic hypertrophy—all these died. So far, there would appear to have been performed only one successful operation for leucocythæmic spleen—that of Franzolini of Turin —and his case is doubtful.* Ashhurst † has collected 43 splenectomies for disease, with 31 deaths; and 21 operations for injury or prolapse—all successful. Nussbaum, however, of 26 cases for traumatic causes, found that only 16 recovered. Gilson,‡ in a careful review of the whole subject, quotes 18 operations for injury, with recovery in all; and 37 for disease, with 29 deaths and 8 recoveries. Podrez of Kharkoff estimates the total mortality as 73 per cent. Mollière § has tabulated 28 cases of coelio-splenectomy for disease, and 11 cases of splenectomy for wound, with results according with the above. Wright of Manchester ‖ has collected and tabulated 62 cases of splenectomy. Of these, 22 were for leukæmia—all were fatal; 23 were for simple hypertrophy—15 died; 7 were for malarial disease—5 recovered; and 3 for cystic disease—all recovered. Asch ¶ has collected 90 cases: of these 51 were successful (14 were for wandering spleen). Statistics, up to April, 1890, have been collected by Dr. M. Howard Fussell of the University of Pennsylvania. They include a total of 105 splenectomies, with 57 recoveries and 48 deaths. Of these operations 28 were for simple hypertrophy, with 19 deaths; 24 for leukæmia, with 23 deaths; 26 for accidents, with 1 death; 16 for floating spleen, with 1 death; 5 for cysts of the spleen, with 1 death; and the rest for rupture, suppuration, pernicious anæmia, and sarcoma. Spanton ** has collected 25 cases of operation for leucocythæmic spleen with 24 deaths, and 75 of non-leucocythæmic spleen with 28 deaths. The latest statistics are those of Dr. Richard Douglas,†† who has collected a list of 194 splenectomies. For leucocythæmic spleen there were 36

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* *Wien. med. Woch.*, 1883, No. 20.   † *Internat. Encyc. Surg.*, vol. v., p. 1103.
‡ *Rev. de Chir.*, April 10th, 1885.
§ *Dict. Encyc. des Sc. Med.*, 1883, Art. "Splenotomie."
‖ *Med. Chron.*, Dec., 1888.   ¶ Abstr. in *Internat. Journ. Med. Sc.*, Nov., 1888.
** *Brit. Med. Journ.*, Nov. 2 and Nov. 9, 1895.
†† *Journ. Amer. Med. Assoc.*, April 25, 1896.

operations with 31 deaths; for simple hypertrophy, 59 operations with 25 deaths; for neoplasms, 5 operations with 3 deaths; for hydatids, 6 operations with 2 deaths; for wounds, 43 operations with 11 deaths.

A dissection of the figures according to the causes of operation shows that the removal of prolapsed or wounded spleen is not only a justifiable but a successful operation; and that the removal of leucocythæmic spleen, even if it gave promise of a cure of the disease, is negatived by its almost uniform fatality. Experience has shown that in leucocythæmia there is a marked tendency to hæmorrhage after operations of any sort; and this tendency, in such an operation as splenectomy where hæmorrhage is always a chief risk, is enough to forbid it. Besides, there is no reasonable ground for inferring that removal of the spleen would have any influence for good on the general disease. Splenectomy in leucocythæmia is, as Bryant puts it, "physiologically unsound and surgically unsafe": it ought, therefore, to be abandoned.

For disease not attended with leucocythæmia, the operation is at least justifiable. For undue mobility the operation has been most successful; for cystic disease the operation has been very successful; while for such conditions as lympho-sarcoma, simple hypertrophy, hypertrophy with cirrhosis, hydatids and abscess, the failures have about equalled the successes.

The present position of splenectomy, therefore, is something like the following: Operations for leucocythæmic spleen are unjustifiable. Operations for traumatic lesions are justifiable and safe. For movable spleen, excision ought not to be carried out till less severe measures, such as mechanical support or operative fixation, have been tried and found ineffectual. For cysts, the spleen may be removed with a fair chance of success; but puncture or incision, with drainage, ought to have a trial first. In the early stages of malignant disease the operation is justifiable. In the rare cases of primary hypertrophy, the operation is permissible if the disease is attended with danger or serious discomfort.

THE OPERATION OF SPLENECTOMY.

The incision in most of the operations has been made in the middle line. This, no doubt, is a result of erroneous diagnosis, and not of operative election. A lateral incision along the outer edge of the left rectus would probably be the most convenient. It would certainly be so in all cases not attended with great enlargement. Küchler and Wells made the entrance through the linea semilunaris; Bryant, a little farther to the outside. In prolapse, the wound may or may not require enlargement.

The tumour being fully exposed, all adhesions are divided and ligatured. It is gently delivered, lower extremity first. If the tissue is not very friable, the use of the myoma screw will be of advantage. Sponges are packed inside the cavity; and the parietes are depressed as much as possible by an assistant, to prevent traction on the pedicle. The tumour must be handled with extreme gentleness; and the most scrupulous care must be given to the avoidance of injury to the vessels in the pedicle, and even to dragging on them, which has been found to produce alarming symptoms of shock.

The success or failure of the operation may be truthfully said to depend on the treatment of the pedicle. Death from hæmorrhage after a few hours has frequently occurred, after what seemed to be the most perfect deligation at the hands of our most skilled operators. A small artery slips from the encircling ligature (as in Thornton's second case); or a ligature slips during straining; or bleeding may commence from the moment the patient begins to rally from the shock. It is clear, therefore, that our surgical technique in this part of the operation is by no means perfect.

Morris* recommends that, before cutting away the tumour, a clamp should be placed around the pedicle, and that it should afterwards be ligatured in two or more parts with strong twisted silk or whipcord. Thornton, in a successful operation, tied the pedicle in two locked ligatures and added a separate ligature

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* *Internat. Encyc. Surg.*, vol. v., p. 1104.

carried round the whole. In an unsuccessful case, he placed three locked ligatures by double transfixion, tying the outer loop first, then the inner, and finally the middle one. Temporary forci-pressure was also employed; yet death occurred from hæmorrhage in a few hours. Thornton, somewhat hypercritically (as it seems to me), blames himself for having tied the middle ligature last. Billroth was able to ligate artery and vein separately; but in this case he must have passed the ligature farther away from the spleen than is usually possible—a supposition which seems the more likely as he removed a portion of the pancreas with the tumour. Franzolini also was able to put a ligature on the artery, which was the size of the forefinger, and another on the vein, which was the size of the thumb; in his case, it was specially noted that the pedicle was short. The gastro-splenic ligament was also surrounded by two ligatures, and the suspensory ligament by one. Simmons, in America, ligatured the pedicle and the gastro-splenic ligament separately and in sections: the patient died from hæmorrhage in two and a half hours. Langley Browne* found no proper pedicle, but four very large arteries, each of which he secured separately by double ligatures, dividing them between: there was no hæmorrhage; but the patient died, in five hours, of shock. In a case of my own where the vessels were large and numerous, I used a triple interlocking ligature, and a single over-all ligature. The patient, after appearing to be almost out of danger, died suddenly on the third day; no reason being found at the autopsy.

No absolute rule can be laid down as to the management of the pedicle; but a few guiding principles may safely be enunciated. Every divided vessel, artery, or vein should be efficiently, and as far as possible separately, ligatured. The ligature should be tied while the pedicle is in a state of relaxation: the tendency of a small branch to retract after being forcibly elongated is thereby obviated. The veins should be ligatured as well as the arteries, because considerable branches communicate with the splenic vein close to the site of ligation. If the splenic branches spread out considerably before entering the hilum; if they are

* *Lancet,* ii., 1877, p. 310.

numerous and intermingled with veins, and not easily isolated; and if the pedicle is not short, the placing of a broad temporary clamp before cutting away the tumour may be found advantageous. In many cases it will be found a good plan to apply pressure forceps in pairs—one pair after another—to each portion of the pedicle which contains a vessel, and divide between them till the whole pedicle has been cut through. Then one forceps after another is picked up, and the vessel or vessels which it grasps are deliberately tied at a safe distance from the forceps. When each vessel has been secured, the whole may be surrounded with a single ligature, tied with moderate force so as to lessen the shock of the arterial pulse on the distal ligatures. Finally the ligatures are all cut short, and the pedicle dropped into the cavity. Sponging, if it is necessary, should avoid the pedicle, which may be kept out of the way by a catch-forceps attached to its extremity.

The gastro-splenic and diaphragmatic ligaments are dealt with in the same fashion by separate ligatures : the same minute care need not be observed, however. Adhesions are treated according to ordinary principles.

The great risk of the operation is hæmorrhage from the pedicle. Of the 29 cases collected by Collier, 14 died directly from hæmorrhage, and 7 from other causes, such as thrombosis (1 case), peritonitis (2 cases), shock (3 cases). Shock is often very alarming, and has appeared during the performance of the operation, specially while traction is being exerted on the pedicle.

Splenopexy.

Movable or wandering spleen is a rare disease, and operations for its cure are still more rare. The proceeding hitherto adopted has usually been removal of the organ. According to Heydenreich,* Dandalo has collected 17 cases of splenectomy for this disease with 2 deaths. Hypertrophy usually accompanies the

* *The Med. Week*, Paris, Feb. 28, 1896.

mobility, and recorded cases might usually be classed under one or other head. For mobility and hypertrophy combined 40 splenectomies were collected by Vulpius, with 13 deaths.

It was inevitable that attempts at fixation should be made to avoid the necessity of removal. Rydygier in 1895 was the first to introduce the operation. Recognising the danger of perforating the vascular splenic tissue and the unsuitability of its soft substance for holding sutures, he made for the organ a sort of pocket by detaching the peritoneum from the parietes, and placed and fixed the organ in it. He entered the abdomen by a median vertical incision, and by examination and placing the spleen in position fixed upon the level and direction most suitable for making detachment of the parietal peritoneum. This was incised transversely with some amount of upward convexity, and detachment made downwards so as to provide a pocket, open above, which would hold the lower half of the spleen. To prevent further downward detachment a few sutures may be placed between the peritoneum at the ends of the incision and the underlying tissues. When the spleen is placed in the sac the edge of the sac is sutured to the gastro-splenic omentum which rests on it. To make fixation more secure the splenic capsule may be scratched, or even a few sutures may be passed through the splenic substance to join it to the edge of the detached peritoneum.

An operation of an allied character is described by Fflücker* as having been performed by Bardenheuer. He entered the abdomen by an angular incision, the angle being at the lower ribs, a vertical limb lying between the ribs and the iliac crest, and a transverse limb skirting the tenth rib. A muscular and cutaneous flap thus outlined was detached down to the peritoneum, and reflected and held on one side. An opening was then made in the peritoneum large enough to permit of delivery of the spleen by its smallest diameter. The parietal peritoneum was drawn together by a purse-string suture round the pedicle of the spleen and fixed to it. The spleen was thus practically made an extra-peritoneal organ. To hold it in this position he

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* *Centralbl. f. Chir.*, Oct. 5, 1895.

placed a suture of silk under the spleen and tied the ends of the suture over the tenth rib. The fixation was made as complete as possible by extra sutures to surrounding tissues; and the musculo-cutaneous flap was replaced and sutured in position.

Zykow or Sykoff,* a Russian surgeon, after experiments on the lower animals, recommends fixation by means of a network of sterilized catgut carried round the organ and fixed by its free ends to the parietes. The catgut is replaced by cicatricial tissue, which holds the organ in place. In several cases the spleen was found diminished in size, apparently through contraction of the scar tissue. This diminution in bulk would, in cases of hypertrophy, be a therapeutic effect of great value.

This last method of Zykow is certainly simple, and it ought to be practically free from danger. Whether it would be permanent experience alone can prove. The durability of the fixation would probably depend on the amount of scar tissue left; and this in turn would depend on the number of strands of catgut employed and the extent of surface covered. This method also in preventing excessive mobility does not, as do the methods of Rydygier and Bardenheuer, produce permanent dislocation of the organ.

* *Vratch*, Sept. 7, 1895; Abstract in *Amer. Journ. Med. Sc.*, March, 1896, from *Archiv. f. Klin. Chir.*, li. 3.

Section XII.

OPERATIONS ON THE PANCREAS.

SUMMARY.

OPERATIONS ON THE PANCREAS.

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THE pancreas must always present a limited field for the exercise of operative surgery. It is not, therefore, surprising that the experience of the last ten years has added little to the thorough and far-reaching work of Senn of Chicago,[*] who may be said not only to have founded but to have built up the Surgery of the Pancreas. Treiberg of Nickolaiev and Lardy for Kocher of Berne,[†] by reports of cases and examination of the literature of the subject, added to our knowledge. Treiberg also made elaborate experiments with a view to discover what, if any, serious effects would follow the withdrawal of the pancreatic secretion from the economy. A good many scattered operations

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[*] *The Surgery of the Pancreas.* Phila., 1886. "The Surgical Treatment of Cysts of the Pancreas," *Amer. Journ. Med. Sc.*, July, 1885.
[†] Leader in *Annals of Surgery*, Nov., 1888.

have appeared in the journals during the past few years, and the operative methods have in consequence become more precise and the results more successful.

Surgical Anatomy of the Pancreas.—The pancreas lies deeply in the abdomen, at the level of the first lumbar vertebra. Its head lies in the concavity of the duodenum; its tail lies in contact with the spleen. It can be reached and exposed to sight by division of the gastro-colic omentum, and by pulling the colon and the stomach apart. In the epiploic sac thus opened, the pancreas is seen lying on the large abdominal vessels. The stomach lies in contact with its anterior surface, from which it is separated by a covering from the "omental bursa." The posterior surface rests on the vena cava, the aorta, the superior mesenteric vessels sometimes surrounded by gland tissue, and the pillars of the diaphragm. Towards the right extremity, it is in relation with the vena portæ. Each extremity of the pancreas lies surrounded by numerous lymphatic vessels and glands, embedded in areolar tissue. The inferior surface rests, at one end, on the junction of the jejunum and duodenum; at the other, on the transverse colon. The middle portion of the inferior surface has a special peritoneal covering, derived from the lower layer of the meso-colon. At the upper border, and behind the posterior surface, are found the splenic artery and vein.

Just above the pancreas lies the cœliac axis. The common bile-duct passes behind the head of the pancreas, close to it and sometimes embedded in its tissue. The pancreatic duct unites with the common bile-duct in the wall of the intestine, at the junction of the second and third portions of the duodenum and three or four inches below the pyloric orifice of the stomach.

The pancreas receives its blood-supply from the splenic artery and the pancreatico-duodenal branches of the hepatic and the superior mesenteric arteries.

Conditions for which Operation may be performed on the Pancreas.— Billroth* successfully removed the pancreas for cancer: no

* *Wien. med. Woch.*, April 3rd, 1884.

report, however, has appeared saying that the patient continues free of the disease. Removal of the pancreas for primary malignant disease can, however, be very rarely a justifiable operation. When it has come within the range of physical diagnosis, it will have invaded the adjacent organs and tissues to such an extent that removal would be either impossible or exceedingly dangerous. The case in which Billroth removed a portion of the tail of the pancreas with a splenic tumour has already been referred to. To remove the head of the pancreas it would be necessary to leave intact the pancreatic duct—a proceeding scarcely possible.

Laborderie* is said to have successfully removed a portion of the pancreas protruding through a wound in the parietes. This operation has, however, been discredited.

Further indications to operate are given by Senn as follows:

" Partial excision of the splenic portion of the pancreas is indicated in cases of circumscribed abscess and malignant tumours, in all cases where the pathological product can be removed completely without danger of compromising pancreatic digestion or inflicting abdominal injury upon important adjacent organs.

" Ligation of the pancreas at a point or points of section should precede extirpation, as a prophylactic measure against troublesome hæmorrhage and extravasation of pancreatic juice into the peritoneal cavity.

" The formation of an external pancreatic fistula by abdominal section is indicated in the treatment of cysts, abscesses, gangrene, and hæmorrhage of the pancreas due to local causes.

" Abdominal section and lumbar drainage are indicated in cases of abscess or gangrene of the pancreas where it is found impossible to establish an anterior abdominal fistula.

" Through drainage is indicated in cases of abscess and gangrene of the pancreas, with diffuse burrowing of pus in the retro-peritoneal space.

" Removal of an impacted pancreatic calculus in the duodenal extremity of the duct of Wirsung, by taxis or incision and

* *Gaz. des hôpitaux*, 1856, No. 2.

extraction, should be practised in all cases where the common bile-duct is compressed or obstructed by the calculus, and death is threatened by cholæmia."

As yet, most of these indications remain to be fulfilled by the surgery of the future. Thus far, systematic and deliberate surgical treatment has got little beyond cysts of the pancreas.

The origin of cysts of the pancreas is not fully understood. As a rule they are developed in the tail, very rarely in the head, of the gland. They, practically, always originate from retention of the pancreatic secretion; but obstruction of the duct is, according to Senn, not the only nor the most important element in their causation. He would regard as the most important etiological factor "an arrest of absorption of the pancreatic juice, due either to a transformation of the pancreatic juice by the admixture of pathological products into the substance which is capable of being absorbed, or to a loss of function in this direction of the vessels which perform this task." The causes of obstruction are: calculus; obliteration of a portion of the duct, by cicatricial contraction; and displacement of the pancreas, with flexure of the duct, caused in various ways.

The size of the cyst varies considerably. The cyst-walls are usually thin in rapidly-growing tumours; and thickened, cartilaginous, or even calcified, in tumours of slow growth. The inner surface either is smooth, or it presents evidences of degeneration similar to those which occur on the internal surface of arteries in the later stages of endarteritis. In cases where the duct is blocked near its extremity, the duct and its branches may become dilated, presenting the appearance of varicose veins. In other cases the cyst is globular. The gland tissue is destroyed by pressure or chronic inflammation. Pure pancreatic juice is found only in small and recent cysts; later on, in old or large cysts, various accidental products are added. Sometimes pus and blood are found.

Diagnosis is possible only when the cyst is large, and then it is rarely certain. Cysts of the pancreas have been found only in adults. A history of painful or inflammatory affection in the region of the pancreas is to be looked for. Colicky pains in the

epigastrium, often of great violence, are sometimes complained of. This symptom has been called cœliac neuralgia, and is said to be characteristic of pancreatic cysts. Frequently the cysts grow with great rapidity. Fatty stools point towards the existence of some co-existing serious lesion, rather than to simple cyst. Digestion is often impaired ; and frequently there is emaciation, sometimes to a very marked degree. Undigested muscular fibre in the patient's stools is suggestive of defective pancreatic secretion. A peculiar pale-yellow or earthy coloration of the skin, which is said to be pathognomonic, is sometimes observed. Diabetes mellitus is occasionally associated with pancreatic disease.

The cyst makes its appearance in the normal situation of the pancreas ; the direction in which it increases will depend on the portion of the pancreas in which it originated. Thus, its most prominent point has been found below the right lobe of the liver, in the epigastric region, and in the left hypochondrium. The stomach is pushed forwards in all cases, and, later, to the right side. The transverse colon is displaced downwards, and the spleen to the left. By inflation of the stomach and bowels and thereby making out its position behind stomach and colon, Kocher, in a patient on whom he operated, was able to diagnose cyst of the pancreas. The tumour, being in direct contact with the diaphragm, may ascend and descend with the respiratory movements. Occasionally the tumour vibrates with the impulse of the abdominal aorta, on which it rests. Fluctuation is not always perceptible in thick-walled or tense cysts. Exploratory puncture, in cases where diagnosis is imperative, may be employed. In a case of pancreatic cyst reported by W. T. Bull, of New York,* fluid withdrawn by a hypodermic syringe was found to be dark-brown, turbid, odourless, alkaline, and of specific gravity 1.010. Chlorides were abundant ; there was no bile, and only a trace of urea. The fluid became solid on boiling. The microscope revealed degenerated cells, fat-globules, granular matter, and hæmatin crystals. When kept at a temperature of 100° Fah. for fifteen minutes with some

* *New Yor Med. Journ.*, Oct. 1st, 1887.

boiled rice, the fluid was found to contain one grain of glucose to the fluid drachm. The fluid also emulsified oil. In this case also free fat was found in the fæces and sugar in the urine, to the extent of ten grains to the ounce.

According to Rotter,[*] a pancreatic cyst may develop in three ways :

(1) It may push forward the posterior wall of the lesser cavity, having in front the stomach and gastro-colic omentum, below the transverse colon and above the liver. Three-fourths of all cases are said to be of this variety.

(2) It may grow between the layers of the transverse meso-colon, so that the colon lies transversely over the growth a little above its centre.

(3) It may develop in the lower layer of the transverse meso-colon, and then grow along its upper boundary.

In connection with cysts of the pancreas, it is necessary to call attention to some very important observations made by Jordan Lloyd[†] on tumours caused by effusions into the lesser peritoneal cavity. These so closely simulate true cysts of the pancreas, that he thinks it probable that many cases diagnosed and even operated on as pancreatic cysts were really effusions into the lesser cavity. Several surgeons in reporting cases have signified their adhesion to this opinion ; and chemical and microscopic studies of the fluids removed lend further weight to the correctness of Jordan Lloyd's conclusions. Many cases recorded as pancreatic cyst have had a traumatic origin ; most of these would probably be effusions into the lesser cavity.

The shape of the cyst formed by the dilated sac suggests the diagnosis. The downward limits vary of course with the extent to which the two layers of the great omentum remain separate ; rarely does it extend the whole length of the omentum. The colon in true cyst of the pancreas is usually below the tumour, and the stomach above : aids to diagnosis may be got by distension of these viscera with gas.

In these cases there is often paroxysmal pain in the

[*] *Zeit. f. Geb. und Gyn.*, xxvii., 228.   [†] *Brit. Med. Journ.*, Nov. 12, 1892.

epigastrium, sometimes aggravated. by eating. There may be vomiting. Emaciation is a marked feature.

Proof of injury to the pancreas is given when the fluid contents convert starch into sugar ; absence of this proof would suggest that it was a simple traumatic cyst.

I think there can be no doubt that Jordan Lloyd is right in his views, and that many of these cases are not true cysts of the pancreas at all, but simple traumatic effusions into the lesser cavity of peritoneum. There may have been rupture of the peritoneal covering of the pancreas or there may not ; a hæmorrhagic effusion into the cavity, or simple inflammatory exudation, may account for the condition met with.

The operation is the same as for true pancreatic cysts ; namely, incision and drainage.

Cysts of the pancreas are most likely to be confounded with ovarian cysts, hydro-nephrosis, circumscribed peritonitis, and hydatids of contiguous organs. In at least three cases, pancreatic cysts have been taken for ovarian cysts by eminent surgeons, after repeated and thorough examination. Of about thirty recorded cases of operation, correct diagnosis was made in about twelve ; namely, in those of Gussenbauer, Senn, Subutoic, Bull, Jacobson, Annandale, Kocher, Küster,* Parkes,† Treves,‡ Filipott,§ and Riegner,‖ and in each of these recovery followed operation.

THE OPERATION.

Tapping or aspiration offers little prospect of success as a mode of treating pancreatic cysts : the fluid would almost certainly reaccumulate. Besides, it might be dangerous as permitting intra-peritoneal escape of the cystic fluid, or by causing injury to omental vessels.

Extirpation has several times been attempted. One operation was performed by Bozeman,¶ with complete success, both

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* *Deutsche med. Woch.*, 1887, Nos. 10 and 11.
† *Amer. Journ. Med. Sc.*, Sept., 1890.   ‡ *Lancet*, Sept. 27, 1890.
§ Abstract in *Annals of Surgery*, Oct., 1890.
‖ *Berl. Klin. Woch.*, Oct. 20, 1890.
¶ *New York Med. Rec.*, Jan. 14th, 1872.

as to the removal of the tumour and cure of the patient ; another by Rokitansky,* who failed to completely remove the tumour, and lost his patient from septic peritonitis.   In both cases operation was performed for supposed ovarian disease : Bozeman recognised the true nature of the cyst during operation ; in Rokitansky's case this was not done till after death. Four other cases are mentioned by Treves, all followed by death. Extirpation is not recommended as the operation of election. If the growth is attached near the tail of the pancreas, and has a marked pedicle, it may be removed with little additional risk : but, in the face of the success which has attended incision and drainage, this additional risk need not be incurred.   In other cases, the situation of the tumour at the head of the pancreas, the absence of a pedicle, and the existence of deep adhesions, might render the operation very difficult, and even impossible. If the cyst-wall were very thin, or rotten or gangrenous, then removal—partial or complete—might be attempted.

Ogston of Aberdeen † operated on a pancreatic cyst which was adherent to the front of the abdomen, almost bursting through it, by elliptical incision around the adherent portion into the peritoneum.   The cyst attachment extended over both kidneys.   No attempt was made to excise the growth ; it was emptied of pea-soup-looking contents, stitched to the abdominal wall all around, and the superfluity of cyst-wall cut off.   The patient died of gangrene of the cyst.   The removal of superfluous portions of the cyst-walls, if they are very thin or unhealthy, is distinctly advisable, if this can be done without causing traction.

The best treatment is, to establish a pancreatic fistula by incising the cyst-wall, and suturing the opening to the parietal wound.

As the stomach and the colon lie above and below the cyst, it will always be wise to commence operation with these viscera empty.   Except in Senn's case, and in Ogston's, the incision was always in the middle line.   A good rule is, to make the incision over the most prominent point of the tumour.   This

* *Wein. Med. Presse*, Nov. 15th, 1885.   † Personal communication.

point will most likely overlie the seat of obstruction, and it will be the situation most favourable for the establishment of a fistula. The length of the incision need not exceed two inches, at first : it may be prolonged if necessary. If adhesions exist between cyst and omentum, and between omentum and parietal peritoneum, these need not be disturbed ; but the fluid contents may be drawn off through an aspirating trocar, and the cyst incised and stitched to the parietes afterwards. If there are no adhesions, the omentum is carefully divided over the cyst, all bleeding points being ligatured ; the aspirating trocar is inserted ; and, as soon as relief of tension permits it, two catch-forceps are made to grasp the cyst-wall and pull it forward. When the cyst is empty, and as far as possible pulled through the wound, the opening made by the trocar is enlarged by scissors sufficiently to admit of the introduction of a large drainage-tube, and sutured to the edges of the parietal incision.

Senn recommends an operation in two stages by packing the bottom of the wound over the cyst-wall with iodoform gauze, and opening the cyst after six or eight days. Probably the most recent experience of direct incision and drainage, in the treatment of distension of the gall-bladder and allied conditions, would cause him to modify this suggestion.

Discharge of pancreatic secretion will probably be abundant, requiring the use of some local application, such as carbolised oil, to prevent it from acting on the skin. The drainage-tube is shortened, and changed for one of smaller calibre, as the depth of the cavity diminishes, and the amount of discharge decreases.

With the obliteration of the cyst-cavity we may, in some cases at least, expect restoration of the continuity of the pancreatic duct. A calculus should be looked for, and, if possible, removed.

Appreciation and Mortality.—Senn reports cases of pancreatic cyst healed by incision and drainage at the hands of the following surgeons : Senn,[*] Kulenkampft,[†] Gussenbauer,[‡] and Hahn,[§]—

[*] *Amer. Journ. Med. Sc.*, July, 1885.   [†] *Berlin Klin. Woch.*, Feb. 13th, 1882.
[‡] *Archiv. f. Klin. Chir.*, vol. xxix., p. 355.   [§] *Centralbl. f. Chir.*, No. 2, 1885.

all of them successful. Ogston's case was more than simple incision and drainage. A successful operation has been recorded by Bull of New York,* and another has been reported by Witzel,† from the Bonn Clinic. Treiberg has collected some ten more cases, and about twenty more have been recorded.

In the following cases removal was either attempted or carried out : Bozeman — case already described — recovery : Rokitansky — case described — incomplete removal, death : Luecke, ‡ tapping, subsequent coeliotomy, closure of abdominal wound, death ; malignancy found post-mortem : Riedel,§ separation of adhesions, hæmorrhage, ligature *en masse*, death from peritonitis : Billroth,‖ difficult enucleation, ligation of large vessel, death from peritonitis. According to Treiberg, extirpation was attempted by Zukowsky, Riedel, Saleer, and Koote. All died except Bozeman's case.

The evidence thus far is strongly in favour of simple incision and drainage, leaving the attachments undisturbed.

* *Loc. cit.*   † *Deutsche Zeit. f. Chir.*, XXX., iii., Aug. 25th, 1886.
‡ Virchow's *Archiv.*, xli., p. 9.
§ *Archiv. f. Klin. Chir.*, xxxii., p. 994.
‖ Reported by Salzar from Billroth's Clinic.

Section XIII.

UNCLASSIFIED OPERATIONS FOR GROWTHS AND CYSTS IN OMENTUM, MESENTERY, PERITONEUM, AND PARIETES.

SUMMARY.
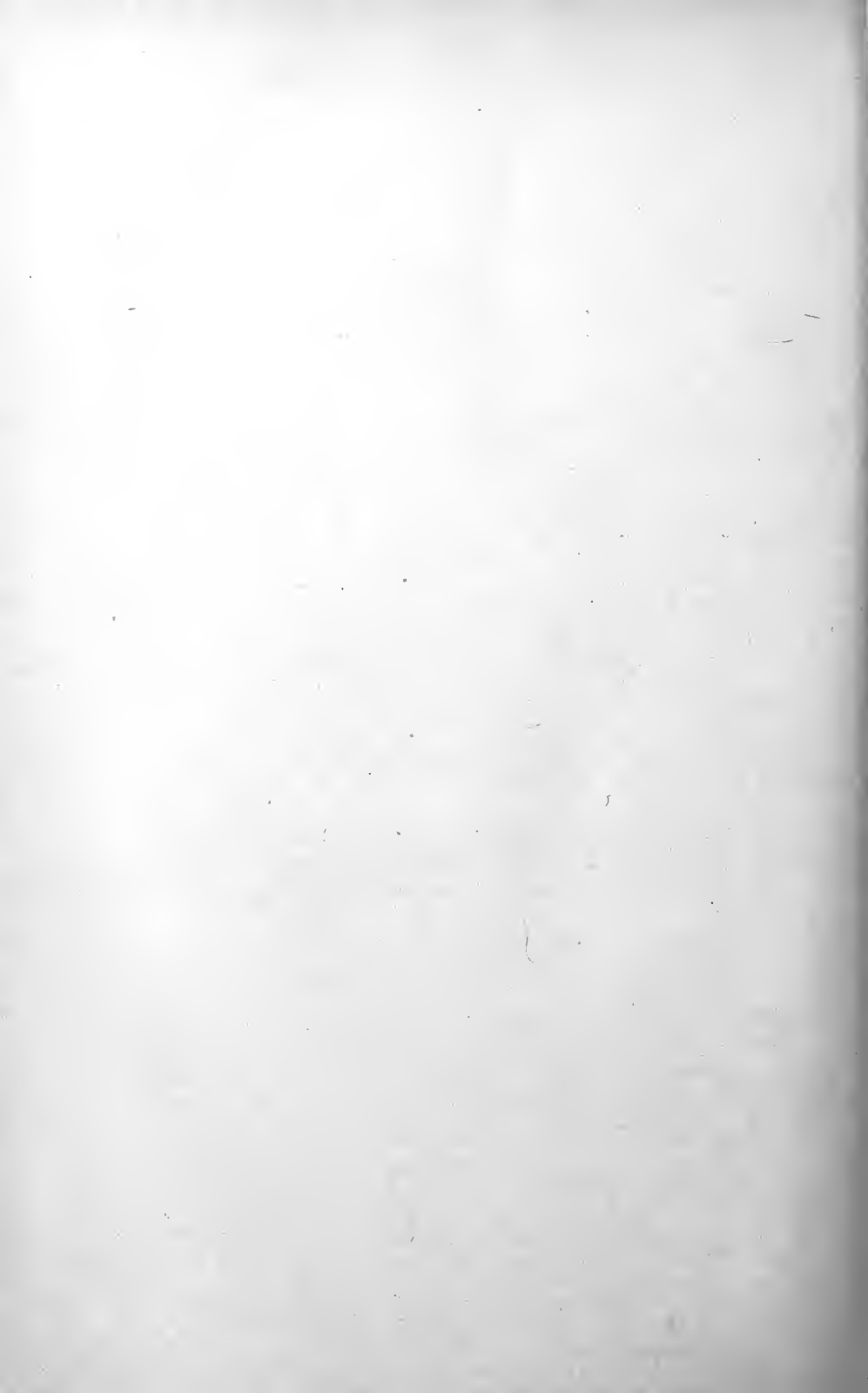
UNCLASSIFIED OPERATIONS FOR GROWTHS AND CYSTS IN OMENTUM, MESENTERY, PERITONEUM, AND PARIETES.

A CERTAIN number of comparatively rare tumours, not connected with special organs, but amenable to surgical treatment, remain for consideration. Such tumours are mainly extra-peritoneal, arising in the sub-peritoneal cellular tissue, or in the parietes. They are rarely diagnosed accurately, and their removal must be carried out without premeditation, and on such general principles as the surgeon has mastered.

Tumours in the Omentum.

Cysts of the Omentum, not hydatid, are of very rare occurrence. A good few examples, in which the tumours have been removed, are, however, recorded. Thornton[*] relates the removal of two small omental cysts during the performance of ovariotomy. One was a small multilocular cystic tumour, of the size of a black Kentish cherry, which was found to be attached by a small pedicle in the lower border of the omentum. The patient had papillomatous cystic disease of both ovaries; and this small tumour, a perfect multilocular ovarian tumour in miniature, Thornton considers, owed its origin to cell-infection. The second was a tumour, of the size of a small cocoa-nut, with a very thick white fleshy wall and a small central cavity, which had a puckered lining membrane and contained three or four ounces of thick yellowish fluid. The tumour was attached by a thick vascular pedicle, and lay up in the abdomen under the border of the liver, and was nearly overlooked during the removal of a large cysto-sarcoma of the ovary. This tumour also Thornton considers to have originated from cell-infection.

Doran[†] relates an interesting example of ovarian cyst attached to the omentum. Dr. Gooding,[‡] of Cheltenham, successfully removed a large cyst, containing clear fluid, from between the folds of the omentum. The tumour had been growing for four years, had caused latterly somewhat troublesome symptoms, and when removed was about the size of a child's head. The cyst was enucleated after a tedious process of separation; there was no pedicle, the growth being embedded in the folds of the omentum, and having the transverse colon below it. The tumour was not hydatid; and Dr. Gooding considers that its origin might have been due to a severe blow on the abdomen, sustained some months before. An example that would appear to have had a similar origin is histologically described by Dr.

[*] *Brit. Med. Journ.*, ii., 1882, p. 1243.
[†] *Obstet. Trans.* xxiii., p. 165.   [‡] *Lancet*, Feb. 12th, 1887.

Ransom* : it had been removed by Sir Spencer Wells some months previously.

Dr. Buckley,† of Manchester, has removed a cholesterine cyst of the omentum, weighing 32 ounces. The cyst was thick-walled and globular, and its contents were cholesterine, fat, and compound granular *débris*,—the whole soluble in ether.

Ormsby‡ removed successfully, from a woman of 26, a multilocular cystic growth, attached by a well-defined pedicle to the omentum, weighing 75 pounds. The nature of the growth is not described in the short notice of the operation.

In 1888 I removed a cystic tumour, attached only to the omentum, from a married woman, aged 44. It consisted of one large cyst, containing nine pints of clear albuminous fluid in a sac of uniform thickness and of pearly-white colour. At the site of its attachment to the omentum were several semi-solid masses, together about as large as the closed fist. Sections through these disclosed, in one portion a cavity containing characteristic dermoid material, with hairs and cartilaginous nodules ; in another part an aggregation of minute cysts, full of clear bright yellow fluid, which floated in globules on water, and was evidently liquid fat. In the largest of these cysts small coherent masses of pure fat were found. The pedicle was simple omentum, about as thick as two fingers. Near the insertion of the pedicle was a fleshy mass, which was the enlarged fimbriated extremity of a Fallopian tube. Not till the growth was examined, after the operation was concluded, did I suspect that the cyst was really ovarian, the pedicle having been twisted through. A thorough examination of the tumour by Mr. Bland Sutton § showed it to be a mixed dermoid and glandular ovarian growth.

Hydatid Cysts of the Omentum have several times been removed. Solitary echinococcus cysts of the omentum are rare. Wickham Legg,∥ Annandale, Witzel, and others have described cases. Witzel,¶ in relating a case of omental hydatid occurring in a girl of ten on whom he operated, takes occasion to fully discuss

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* *Brit. Med. Journ.*, Nov. 8, 1890.   † *Brit. Med. Journ.*, May 16th, 1885.

‡ *Brit. Med. Journ.*, i., 1883, p. 578.   § *Brit. Gynæc. Journ.*, Nov., 1887.

∥ *Trans. Path. Soc.*, xxv,, p. 160.   ¶ *Deutsche Zeitschr. f. Chir.*, 1883.

the symptoms and treatment. Pain, lateral and upward mobility, movements synchronous with the respiratory acts, and certain digestive disorders, are, in addition to the physical signs, the leading features of the disease. As to treatment, he recommends, if there are adhesions, incision and drainage. If there are numerous hydatids in the lower portion of the omentum, he recommends removal of the omentum, after the application of a number of ligatures above the growth. Solitary echinococcus should be treated by incision, after fixation to the parietal wound with sutures, and drained. A small echinococcus cyst might be shelled out of its bed in the omentum without being opened.

Abscess occurring in an omental sac is of the nature of a localised suppurative peritonitis, and its treatment is identical.

Sanguineous Tumours of the omentum are very rarely met with. Dr. Reamy, of Cincinnati,* relates three cases of semifluctuating growths of the omentum, which yielded pure blood on being tapped. These were sarcomata, as indeed are probably all such growths. Doran, Thornton, Gardner, and others have related similar cases. Bristowe† relates a case in which cure followed several evacuations of pure blood by tapping, and which might have been an omental cyst ; but was, in Bristowe's opinion, more probably either a hæmato-nephrosis, or a cyst of the spleen.

Malignant disease of the omentum, either local or as a part of general peritoneal cancer, requires no description.

Tumours in the Mesentery.

A considerable number of operations for mesenteric cysts and tumours have been recorded.

Sir Spencer Wells ‡ in 1882 operated on two occasions for mesenteric growths, one being cystic and the other solid. He

* *Trans. Am. Gyn. Soc.*, viii., 1883, p. 123.
† *Lancet*, May 5th, 1883.   ‡ *Brit. Med. Journ.*, Dec. 9th, 1882.

incised and drained the cyst : the patient died after a few weeks ; and as no further examination was permitted, the exact nature of the disease was not ascertained. The solid growth, which was about the size of a child's head, was successfully removed by enucleation. Its origin was in the cellular tissue at the root of the mesentery proper, near the lumbar vertebræ. The ascending colon was closely connected with the tumour, in front and to the right ; and all its blood-supply was derived from the mesenteric vessels. The exact nature of the growth is not recorded. A case of mesenteric fibroid tumour, weighing 13¼ pounds, in which death followed operative removal, has been recorded by Dr. Brookhouse* of Nottingham.

Lipoma of the mesentery has been met with, and removed. Terrillon† recently presented to the Academy of Medicine of Paris a patient from whom he had removed a fatty tumour weighing fifty-seven pounds, by enucleation from between the layers of the mesentery.

Homans‡ of Boston has recorded two cases of removal of enormous fatty tumours from the abdomen, which were retro-peritoneal, and may have been originally mesenteric. In fact, mesenteric tumours might properly be classified under the more comprehensive designation of retro-peritoneal. Homans' first case was that of a man aged thirty-nine. The girth at the umbilicus was 42¾ inches ; and the tumour felt so fluctuating in parts, that it was punctured several times in the expectation of finding fluid. A first attempt to remove it failed, and a second and successful attempt was made some months later. The operation was one long and tedious process of enucleation from behind the peritoneum and bowels. The patient sank from shock. His second case, in a woman of sixty, was very similar to the first : this patient also died of shock.

Cooper Forster showed at the Pathological Society, in 1868, an enormous fatty tumour, removed after death from a woman, which had features in common with those described by Homans.

* *Brit. Med. Journ.*, Oct. 18th, 1890.
† Letter in *Journ. Amer. Med. Assoc.*   ‡ *Lancet*, i., 1883, p. 449.

Three other cases are described in the Pathological Society's *Transactions*. A similar case is said by Homans to have occurred in the practice of Professor Calvin Ellis, of Harford University. A few more cases have been recorded, but no new facts have been brought out.

Cysts of the Mesentery have attained to dimensions so considerable, that they have been mistaken for ovarian tumours. Péan[*] described three such operations, with one success. Watts[†] relates another case of operation for mesenteric cyst mistaken for ovarian cystoma. Carter[‡] operated on a cyst which sprang from the left side of the spine in the lumbar region where the mesentery is attached, and arose either between its folds or from the sub-peritoneal tissue below it. It contained about sixteen pints of a thin, clear, slightly opalescent fluid, free from albumen, and containing a large amount of chlorides—in fact, presenting characters identical with the fluid found in hydatid cysts. No hooklets or other structures characteristic of echinococcus were found. The patient was a married woman, aged 44. There was a history of two years' growth of the tumour with some pain. On opening the peritoneum, the tumour appeared as a thin-walled cyst, covered in all directions with large veins. It was tapped, and found to be attached to the side of the spine and in the left lumbar region, while it was closely surrounded by coils of small intestine which were firmly adherent to it. An attempt was made to enucleate it; but hæmorrhage was so free that the operator had to desist, and finished by stitching the cyst-wall to the parietal opening, cutting away as much of it as possible, and draining the cavity. The patient died of septicæmia and bleeding.

It would appear that some of these mesenteric cysts contain a fluid which is identical with chyle. Tumours described as chyle-cysts of the mesentery have been removed by von Bergmann,[§] Fetherston,[||] and Rasch.[¶]

[*] *Tumeurs de l'Abdomen.*   [†] *Amer. Journ. Obstet.*, 1879, xii., p. 333.
[‡] *Brit. Med. Journ.*, Jan. 6th, 1883.
[§] *Langenbeck's Archiv.*, 1887, s. 201.   [||] *Austral. Med. Journ.*, June 15, 1890.
[¶] *Trans. Obstet. Soc.*, Lond., xxxi.

About fifty cases of operation for mesenteric cysts have been reported. Complete knowledge of the origin of these rare tumours is far from being attained, but enough is known about them to justify some attempt at classification. Braquehaye,* after a complete study of the whole subject, divides mesenteric cysts into five classes :

I. *Traumatic Cysts, Sanguineous, Sero-sanguineous and Serous.*— These arise from rupture of a blood-vessel between the layers of the mesentery, with extravasation of blood into the areolar tissue. The blood may be diffused or may become encysted, forming a hæmatoma. The natural changes in clot may result in the formation of a cystic tumour containing liquid blood, or blood-tinged serum or pure serum. The rupture of a vessel into a simple cyst may produce a condition identical clinically with a true traumatic cyst.

II. *Lymphatic Cysts*, or cysts containing chyle, are the most common. These may originate in the thoracic duct, in the chyliferous vessels or in the lymph glands ; most frequently in the glands. The contents of the cyst are a white, milky fluid containing albumen. It is clarified by being shaken up with ether. Glandular cysts are said to contain clear serous fluid. There is often a history of traumatism.

III. *Congenital or Dermoid Cysts.*—Congenital cysts are usually dermoid ; but mesenteric cysts are said to originate also in the diverticula of Remak, and in the remains of the Wolffian body. Dermoid cysts are known by their contents—teeth, hair, and sebaceous material,—and by their dermic lining.

In addition to these, Braquehaye describes (IV.) *Parasitic or Hydatid Cysts*, which may lie between the layers of the mesentery as well as everywhere else in the abdominal cavity, and (V.) *Cysts* forcing their way between the layers of the mesentery *from neighbouring organs*.

Symptoms.—The smaller tumours produce no symptoms and are accidentally discovered post-mortem. As the tumour increases in size and becomes palpable subjective symptoms arise. These are usually of a character associated with dyspepsia, being pain,

* *Archiv. Gén de Méd.*, 1892.

flatulence, and occasional vomiting with emaciation. As the tumour grows, the symptoms become aggravated, and may become so acute as to simulate the symptoms of strangulation of the bowels. Indeed, occlusion of the stretched or flattened gut is to be apprehended in every case. Death may be caused by obstruction, or by rupture of the cyst, or by general malnutrition.

In making the diagnosis from other cystic growths inside the abdomen, we may note that in mesenteric cysts of small size the tumour lies deeply; is covered by bowels; is perfectly globular; is movable in all directions, and freely fluctuates. There is resonance between it and the pubes even if the growth is large : an ovarian cyst is nearly always dull on percussion from pubes upwards. Over the largest tumours the flattened and stretched bowel may occasionally be felt through the parietes, causing a linear depression over the surface. The physical diagnosis from encysted peritonitis is impossible; in mesenteric cysts we may expect greater urgency of symptoms.

<div align="center">OPERATION.</div>

Mesenteric cysts seriously endanger life, and should be operated upon at once on the diagnosis being made. The operation of election should be incision and drainage after suture of the cyst-wall to the parietes.

Extirpation has, according to Braquehaye, been done in 20 cases with 8 deaths. The operations have been often very difficult and prolonged, and attended with free hæmorrhage. Incision and drainage has been the method employed in 24 cases, with 2 deaths, and 1 recurrence requiring subsequent removal. It is possible than one of the deaths was caused by iodoform poisoning; and recurrence may have arisen from too early removal of the drainage-tube. Aspiration, or puncture with injection of iodine, have given a few doubtful successes.

The operation itself is simple enough. Section of the parietes is made over the most prominent part of the tumour. The cyst-wall, evidently covered by peritoneum, is inspected to make

certain that puncture is not made through flattened bowel which may be in the wall of the sac. The fluid is removed by aspiration; as the cyst-wall collapses a forceps is placed on it close to the evacuating needle and pulls it into the parietal opening. When fluid ceases to flow a large rubber tube is placed in the opening, fitting it tightly or even stretching it. A continuous suture attaches the cyst-opening to the edge of parietal incision, and the operation is finished. A suture or two may be required to close the parietal wound around the drainage-tube. Packing with gauze; mopping out the cavity, or the application of irritating or antiseptic solutions, are quite superfluous, and apparently not free from danger. The cavity will spontaneously heal if efficiently drained. As the fluids discharged decrease in amount, the drainage-tube may be diminished in calibre. It ought to reach to the bottom of the cavity so long as it is kept in place.

Adhesions to bowel are sometimes found in these cases; no attempt should be made to separate them. No doubt the bowels in some cases of large growth are sessile, because their mesentery has been opened up by the spreading tumour; these are not adhesions to intestine in the ordinary sense. So much difficulty has been encountered in the separation of adherent intestines in these cases, and so much hæmorrhage has resulted, that it is possible the attachment was not peritonitic at all, but approximation from opening up of the mesentery of contiguous coils.

Extra-peritoneal Parietal Cysts.

Extra-peritoneal cysts underlying the anterior abdominal wall form an exceedingly interesting class. In most of them a connection with the urachus has either been demonstrated or rendered highly probable. An exceedingly valuable report of twelve such cases, operated upon by Lawson Tait,* has been published. Of the 12 operations, 4 died, and 8 recovered.

* *Brit. Gynæc. Soc. Journ.*, Nov. 6th, 1888.

The origin of all of them he is inclined to ascribe to a patho-
logical process in some way connected with an arrested or
imperfect closure of the urachus.   In three of the cases there was
found to exist a connection between the bladder and the cyst.

In his first case, the cyst-wall appeared after division of all
the layers except the peritoneum.   Thirty pints of brown thick
fluid, with an abundant flaky yellow deposit consisting chiefly of
pus and mixed with large fibrinous masses, were removed by
tapping.   The cyst-wall was completely enucleated without
entering the peritoneum.   " The cyst did not dip into the pelvis
at all, and the anterior parietal peritoneum did not reach the
wall lower than the ensiform cartilage.   The intestines and the
pelvic organs could be felt through the anterior peritoneal fold,
non-adherent, and, as far as could be determined, perfectly
healthy."   The inner surface of the " cyst consisted of broken-
down mucoid epithelium, infiltrated everywhere with pus lying
upon the basement membrane, which consisted almost entirely
of muscular fibres."   The patient died, in three days, of
exhaustion.

In the second case several pints of putrid urine were
evacuated from the cyst, and the patient recovered with a urinary
fistula.   She died, a month later, of the effects of a miscarriage.
In the third case, the patient was in an almost helpless condition,
from suppuration in the cyst and gangrene of its walls, and died
of exhaustion from excessive suppuration seventeen days after
operation.   The condition in this case was very similar to that
found in the first.

In the fourth case, the peritoneum covering the cyst left the
abdominal wall about two and a half inches above the umbilicus,
and " presented a curvilinear fold running down outwards and
backwards symmetrically on each side to about the middle of
the crest of the ilium, and this was reflected at once on to
the promontory of the sacrum.   Behind this apron, consisting
of the cyst-wall and peritoneum united, the intestines and other
organs could be felt.   The whole of the pelvis was entirely
destitute of peritoneum, and was occupied instead by a cyst-wall ;
and standing up in the middle of the cavity, bounded on both

sides by the cyst-wall, was the uterus, and what ought to have
been the broad ligaments. The bladder had a similar relation
to the cyst-wall that it ought to have had to the peritoneum;
and then from the base of the bladder, running up and lining
the posterior surface of the transversalis fascia, was the con-
tinuation of the cyst-wall. The fluid of the cyst was clear, and
floating in it were shreds of delicate membrane, with lumps of
fat in it, presenting precisely the appearance of the omentum of
the fœtus." The cyst was emptied, sponged out, and drained.
Suppuration set in, and killed the patient six weeks after
operation.

The fifth, sixth, seventh, eighth, and ninth cases were very
similar to the fourth. The tenth case had been previously
operated upon by another surgeon. The cyst-walls "were of
that peculiarly gelatinous friable material which is common to
all these cases." After dissecting through the posterior wall of
the cyst, the operator found immediately underneath it the loose
vascular serous tissue observed in some of the other cases.
Dissecting carefully on, he came upon a piece of intestine, and
then with his fingers found that he "could readily separate the
coils, which were attached to it, not by adhesions, but by
connective tissue, very extensile, and what we are perfectly
accustomed to in all regions which are immediately connected
with organs not enveloped in the peritoneal layers, the appear-
ances being totally different from those of inflammatory
adhesions. The cyst travelled everywhere down into the pelvis,
and the pelvic organs could be felt through its walls." It seemed
to the operator that this patient had no peritoneal cavity at all,
and that the intestines lay enveloped in fat and loose extensile
cellular tissue.

Cases xi. and xii. were not unlike the others. Portions of the
cyst-wall of case xi. were removed, and submitted to microscopic
examination by Mr. Bland Sutton. He found a "mixture of
fibrous and non-striated muscle tissue, arranged in fasciculi
closely corresponding to the disposition of the bundles of tissue
which make up the walls of the urinary bladder. Scattered
throughout the whole thickness of the sections were small

calcareous nodules. It was difficult to make out any definite epithelial investment to the section ; but on scraping the smooth surface of the specimen with a cover glass, the field of the microscope became crowded with flattened, rounded, and pyriform cells, similar to those found lining the interior of the urinary bladder, only very much smaller." Mr. Sutton considers that "as the urachus is lined with epithelium agreeing in shape, and continuous with that found in the interior of the bladder," the evidence in favour of these cysts being allantoic is complete.*

Bantock† relates two cases very similar to those of Tait.

Certain cases of retro-peritoneal cysts containing chylous contents have been recorded.‡ These are probably connected with the thoracic duct or other large lymph channels. The treatment is incision and drainage.

Tumours not cystic are found in connection with the urachus —sarcoma, for instance. I have met with two cases of sarcoma. Mr. Ewens recently exhibited at the Bristol Medico-Chirurgical Society a remarkable specimen of sarcoma of the urachus which he had attempted to remove. Such cases have, however, a pathological rather than a practical interest.

New growths in the parietes, originating in the muscles or fasciæ, though they bulge inwards on the peritoneal cavity and may require removal of peritoneum before they can be completely eradicated, do not require special description. Weir § has operated successfully on one of the most remarkable cases of˙this sort : the tumour weighed nearly fourteen pounds. Briddon, Thomas, Heineke, Czerny, and others have had similar cases. Sarcoma is the form of new growth most frequently met with in the parietes. Around or in the umbilicus are found polypus, papilloma, fibroma, and epithelioma. I have seen a case of epithelioma of the umbilicus complicated with intestinal fistula. Most cases of cancerous growth in the umbilicus have been, in

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* For further information concerning Allantoic cysts, consult Bland Sutton's *Introduction to General Pathology*, where also further references may be found. An exhaustive paper on *Abnormalities of the Urachus*, by James A. Freer, of Washington, is published in the *Annals of Surgery* for Feb., 1887.

† *Brit. Gynæc. Soc. Journ.*, Nov., 1886, p. 348.

‡ Kilian, *Berlin Klin. Woch.*, xxv., 1886.   § *N. Y. Med. Rec.*, Dec. 3rd, 1887.

my experience, secondary to a similar growth in the cavity. In some cases the umbilical growth appears before there are signs or symptoms of intra-abdominal growth. One such I removed at the Bristol Infirmary, when examination by finger inside made out nothing abnormal. The patient, however, returned in six months with a cancerous abdominal growth of considerable size.

For all such rare and peculiar conditions, definite and precise rules for operative treatment cannot be laid down. Most cases come upon the surgeon as a surprise; and their operative handling must be decided upon on the spur of the moment, and carried out according to broad principles established for abdominal operations in general.

Peritoneal Sanguineous Cysts

Form a class of abdominal tumours which is by no means well understood. It is certain that from the pathological point of view they cannot be spoken of as one class; from the surgical and the clinical points of view, however, they may conveniently be classed under one heading.

Many isolated cases of encysted peritoneal collections have been recorded; but so far as I know, no systematic attempt has been made to classify the varieties. A conspicuous exception to this statement must be made for sanguineous peritoneal cysts, our knowledge of the pathology of which the able and elaborate paper of Dr. Theodore Fisher* has greatly advanced. It would be quite beyond the limits of this work to enter into a discussion of these somewhat rare conditions, or to reproduce the various theories which different writers have advanced to account for them. It will perhaps suffice if the broadest clinical features are laid down, and the best modes of treatment.

* *Guy's Hosp. Rep.*, xlix., 1892.

The origin of all varieties of peritoneal cystic collections is frequently traced to a blow or other injury in the region affected. There are many exceptions to this rule, however. Before any tumour appears the patient may complain of obscure abdominal troubles, of which pain, occasional vomiting, and constipation are the most striking. There may be loss of flesh to a marked degree, so much so as to suggest the presence of malignant disease.

After a time a tumour appears; and its appearance is with remarkable frequency described as sudden. In a few cases it slowly increases in size in others it remains quiescent. In a few of the cases of sanguineous cyst there is discharge of blood into the intestines or the stomach, producing melæna or hæmatemesis. The clinical signs are simply those of a cyst containing fluid which lies in contact with the abdominal wall in front and extends upwards, downwards, and laterally in a great variety of ways. They are most commonly found in the upper and middle abdomen.

These cysts, though they may remain stationary for prolonged periods, are practically always associated with illness on the part of the patient, and measures for relief are always necessary. Also they are not free from danger. One case is recorded by Fisher as having terminated fatally from peritonitis caused by rupture. Several have burst into the bowel.

The origin of these cystic collections is ascribed by Fisher to some nerve lesion, and he supports his view by cogent arguments. Possibly some of the collections of fluid might be explained as resulting from changes originating in bloodclots. That cysts may form in clots, and indeed always do in large clots, I have satisfied myself in investigations undertaken in the first place to trace the behaviour of clot in fracture and continued as opportunity offered in the study of clot found elsewhere. Also we know how prone clot is to liquefy and to borrow serum from the surrounding tissues to help it therein. Quite recently I saw a cyst over the sacrum, freely fluctuating, and which must have contained a pint of fluid, which originated in a small subcutaneous clot formed by a blow from a [cricket

ball. The peritoneum is ready enough to supply fluid; a small clot liquefying may get as much fluid as it wants. Therefore, I think that some, at least, of those peritoneal sanguineous cysts may have their origin in a bloodclot left after a blow and becoming liquefied and diluted by serum. The late occurrence of the cyst, dating from the blow, and its rapid increase when once liquefaction has started, would be quite in harmony with what we know of the behaviour of clot in wounds or after subcutaneous injury.

The relation of these cysts to so-called cysts of the pancreas is an interesting question. Jordan Lloyd, as elsewhere reported (p. 1052), has raised the question as to whether many of the cases of recorded pancreatic cyst are not really cystic collections in the lesser cavity of the peritoneum; and the side-light thrown on his position by a consideration of these peritoneal cysts further illustrates and supports his view. The position and relations of the cysts are similar: each often follows injury, blood is a common constituent of the fluid, and a history of dyspeptic troubles is common to both varieties. Fisher's view is essentially that of Jordan Lloyd. He considers "that an effusion primarily sanguineous may soon fail to give marked evidence of the presence of blood, and that the pancreatic cyst originates in a blood effusion not necessarily arising in the gland itself." That Fisher and Lloyd are each right in their views I am fully convinced. After reading Fisher's criticism of the recorded cases of pancreatic cyst, and giving due weight to Lloyd's closely reasoned paper and carefully recorded cases, one can scarcely avoid the conclusion that half the cases reported as pancreatic cyst were not such at all; but were really examples of cystic peritoneal effusions having a different origin.

As to the treatment, evacuation and drainage would seem to be the most successful. Tapping, according to Fisher, was employed in 8 cases: in 4 one operation was sufficient, in 2 the operation was repeated once successfully, in one the cyst partially refilled after a second aspiration, but was permanently cured by bursting into the bowel, and in the eighth, in a man aged 76, death took place apparently from

pleurisy, but not obviously as the result of treatment. Injection of antiseptic fluids in 4 cases resulted in 2 deaths. Coeliotomy with stitching of the cyst to the parietes was successful in the 2 cases in which it was carried out. In 4 extirpation of the cyst-wall was attempted: 2 died. Our knowledge of the surgery of similar conditions and of its results would indicate that for such cases the safest and most certain result would be got by exposure of the cyst after section of the parietes; emptying it by aspirator; and drainage for a few days, either with or without stitching of the cyst-wall to the parietes.

Section XIV.

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OPERATIONS FOR ABDOMINAL INJURIES.

SUMMARY.

OPERATIONS FOR ABDOMINAL INJURIES.

This Section might, not improperly, have been named The Reparative Surgery of the Abdomen. It includes the whole subject of traumatism as connected with the abdominal viscera, so far as it can be dealt with by surgical methods. In description it is impossible to treat the various subjects on identical lines or with even balance of detail. Thus special consideration must be given to Gunshot Wounds generally; and subsidiary accounts are added of such specific accidents as Rupture of the Urinary Bladder, and Rupture of the Intestines.

Gunshot Wounds of the Abdomen.

History.—The treatment of gunshot wounds of the abdomen by coeliotomy is one of the latest developments of modern surgery. Up to 1885, according to Parkes, only six operations for this class of injury were recorded. Dr. Kinloch of North Carolina operated in 1863. Coley* tells us that the first coeliotomy for gunshot wound of the abdomen was by Baudens in 1836. He resected eight inches of the small bowel, and united the ends by Lembert's sutures. After the death of the patient three days later, an undiscovered wound of the cæcum was found. Baudens operated a second time for wound of the transverse colon; in this case simple closure of the wound was followed by recovery. Kocher of Berne had a success in 1883. Among the most remarkable of coeliotomies for gunshot wound was one by W. T. Bull

* *Boston Med. and Surg. Journ.*, Oct. 10th, 1888.

of New York, performed in 1885, in which no fewer than seven intestinal perforations were discovered and closed. The patient made a complete recovery.* To this, in the following year, he added another success quite as remarkable.† In Kocher's case,‡ operated on three hours after receipt of injury, the stomach was perforated. At the Berlin Congress of last year, Bernays of St. Louis presented five remarkable cases operated on by himself, with three successes. Senn of Milwaukee has been prominent in the successful introduction of new methods for assisting diagnosis and treatment in these cases. The subject was forced into prominence by the interest manifested and the correspondence published in connection with the murder of President Garfield by a gunshot wound of the abdomen; the usual hopeless results of these injuries when untreated, and the success of certain operations, combined with the general improvements in abdominal surgery, have now resulted in placing the treatment of gunshot wounds of the abdomen among justifiable and beneficial operations. Towards this result American surgeons have contributed by far the most important part.

ANATOMICAL CONDITIONS.

Although in recent wars there has been no lack of opportunity for studying bullet wounds of the abdomen, nor dearth of description of the effects produced, yet, from the fact that these reports have been compiled from the pathological rather than the operative standpoint, we have few definite data to guide us in making inferences from the nature of the external wound as to the character of the lesion produced. Studies of the results of certain experiments on the lower animals, and of the details furnished in the descriptions of operations, provide valuable supplementary knowledge which may be used to guide us in undertaking these operations.

It may be inferred that a ball, entering the walls of the

* *Boston Med. and Surg. Journ.*, Nov. 27th, 1885.
† *Ann. of Surg.*, Dec., 1885.
‡ *Corresp. Bl. f. Schweiz. Aertze*, Nov. 23rd and 24th, 1883.

abdomen, pursues a straight course through it.   It is true that a
ball, entering the parietes at one point, may pass in a curved
direction under the skin and make exit, or be imbedded at a
position not in the line of trajectory.   But this is rare, and can
occur only when the skin is struck very obliquely, and the force
of the ball is somewhat spent.   If the ball has made an exit, the
practical inference must be that its course has been in a straight
line between the points of entrance and exit, unless there are
positive evidences—in sub-cutaneous discoloration, or the course
as indicated by a probe—that the reverse is the case.   If the ball
penetrates the parietes, but makes no exit, we must infer injury,
greater or less, to the underlying organs.

Some information may be derived from the character of the
parietal wound.   A large wound argues a large ball from a large
firearm, and, in the majority of cases, the most extensive injuries.
It is true that shots from guns are usually fired at a considerable
distance; but their initial force is usually much greater than
that from revolvers which are fired close.   From any sort of
firearm a close shot will, in most cases, cause deep penetration;
close discharge may often be inferred from the presence of powder
marks around the wound.   The nature of the clothing, presenting
a strong or a slight obstacle to the ball, may affect the depth of
penetration, but not in a degree to be practically estimated.   A
wound that is clean cut, and equally stained all round, usually
indicates that the ball has struck the parietes at right angles to
the surface.   Unequal staining of the edges, with want of
uniformity in the lips of the wound, suggest oblique impaction.
A long, abraded, or bruised track of surface, leading up to the
perforation, suggests very oblique impaction with a possibility
that the cavity has not been penetrated.

It is rarely possible to get trustworthy information as to the
course of the bullet from the position which the wounded person
held when the shot was fired.   We may be told that the shot
was fired from the front, or the side, or the back; but anything
like an estimate of the angle at which the body was struck is
rarely provided by patient or onlookers.   Where there have been
struggles, this difficulty is increased; and in such cases also the

injury may have been inflicted while the patient's body was bent or contorted, so that the track of the ball, with the patient in bed, may be devious, while it may have been perfectly straight in the position held during the infliction of the injury.

It will be seen, therefore, that, in the case of one wound, a consideration of external circumstances will at best supply only probable deductions as to the two important facts of penetration of the parietes and direction of the ball. In a few cases both probabilities may rank almost as certainties; in a greater number, one inference may be made with certainty, while the other cannot; certainty in every case can be secured only by an examination of the wound. In cases of large wound with thin parietes, the fact of penetration may prove itself by the appearance of omentum or bowel in the wound. Senn advises against the use of the probe for diagnostic purposes. The tortuous wound-canal can rarely be followed by a probe without risk of the formation of false passages; and the evidence deduced from probing is always liable to misinterpretation. The injection of hydrogen gas along the bullet-track, as suggested by Senn, is a valuable means of diagnosing penetration. If there is no penetration, the gas will probably escape at once through the aperture of exit; to prove conclusively that the peritoneum is not perforated, the wound of exit is compressed, when the pressure on the gas-balloon is at once increased, and emphysema appears along the bullet-track. If the peritoneum is perforated, the gas will find its way into the cavity, causing general tympanites. It may be advisable, in cases where there is doubt, to examine the wound by incision. This is done by cutting down on a grooved director, which is pushed in by successive steps as far it will easily go, the bruised and discoloured track being exposed to view at each division by the knife. With the help of retractors, the peritoneum at the bottom of the track may be freely exposed to view, when a minute inspection will finally decide conclusively as to the fact of penetration. If there is no penetration and there is no wound of exit, the bullet may be looked for and removed.

The nature of the injuries inflicted, varying according to the size of the bullet and the force of it, and according to the angle

of impact on the organ, is yet fairly constant for each individual organ. The chances of any individual organ being struck vary directly according to the surface it presents. A ball traversing the anterior parietes can scarcely fail to injure bowel, while the chances of injury to liver, spleen, kidney, stomach, or bladder vary according to the route of the ball and the size of the organ. Again, a ball passing perpendicularly through the renal cortex produces very different results from one passing obliquely along the renal vessels and through the pelvis. A ball passing clean through the right lobe of the liver produces very different effects from one crossing the track of its great vessels. It is unnecessary to multiply examples of effects, which must suggest themselves to every surgeon. For practical purposes, the size and rapidity of the projectile may be ignored. Although a large and nearly spent ball produces more extensive injuries than a small or rapidly moving ball, yet the effects of the latter are quite serious enough to greatly endanger life, and make an almost equally urgent claim for operative treatment. In the case of a rapidly moving and small ball passing obliquely through the thicker walled hollow viscera, such as the stomach and the duodenum, it has occasionally been noted, once during operation, that oblique perforation need not be followed by extravasation. But this possibility cannot be counted upon as a probability; if the contents do not escape at once, they may do so later on, when suppuration or sloughing has set in. For practical purposes, therefore, perforation of the hollow viscera by bullet-wound must always be reckoned as leading to extravasation of visceral contents.

It has truly been said that the tendency of every gunshot wound of the abdomen is towards death. In the great majority of cases death is due to a form of peritonitis which is usually described as septic. No doubt the peritonitic fluids are septic; but it is doubtful if the death is not owing to severe shock rather than to true blood-poisoning. In more than 90 per cent. of the cases attacked with peritonitis, death takes place within forty-eight hours. It is true that the peritoneum has a limited power of disposing of septic fluids. The experiments of Grawitz and

Wegner showed for the lower animals this fact, which has occasionally been observed in human beings. But this power of the peritoneum has an infinitesimal influence in lessening the death-rate from this class of injuries. Even if there has been a moderately perfect plastic closure of a perforation, the edges of a bullet-wound are so liable to undergo sloughing, that a secondary perforation usually takes place. A separated slough cast loose into the cavity has great dangers of its own; a slough of the mesentery which cannot fall into the bowel is, in this sense, more dangerous than one on the intestinal wall.

Bleeding is, in itself, rarely fatal; but the extravasated blood, when infected by free visceral fluids, provides pabulum for the extension of septic inflammation, and so adds to the danger. A small number of deaths has been caused from loss of blood through division of some of the large vessels. This is more likely to result from wounds involving the solid viscera and their vessels than from injuries to the hollow viscera.

SYMPTOMS AND DIAGNOSIS OF VISCERAL INJURY.

As recent practical experience and accurate clinical records thereof have done much to discredit the value of the usually accepted symptoms of perforations of viscera, and as incontrovertible physical signs are very rarely met with, the diagnosis must in many cases be matter of inference from the ascertained course of the ball.

Definite physical signs are afforded when there is escape through the parietal wound of the fluid contents of any of the hollow viscera, such as bile, fæces, urine, or partially-digested food, and when there is a discharge of large quantities of blood in vomit, fæces, or urine. Both sets of signs are very rare: and the value of the escape of blood, as a sign of injury to the hollow viscera, is diminished by the fact that a severe contusion may cause a considerable intra-visceral hæmorrhage. The escape of a large quantity of gas from ruptured bowel, which rises to the top of the cavity, and causes increase of resonance, and perhaps does away with liver dulness by getting between liver and

parietes, has been spoken of as an unequivocal sign. Tympanites, however, may produce signs very closely simulating the presence of free gas.

Senn of Milwaukee,* after a series of carefully-conducted experiments, has recommended the method of inflation by hydrogen gas through the rectum for the purpose of diagnosing visceral perforation. He found experimentally that the gas passed the ileo-cæcal valve under an increase of pressure that was neither great nor dangerous, while it was practically impossible to distend the intestine by inflation through the stomach. He himself has employed it in three cases of shot-wound, and with most satisfactory result in all. In one, perforation of the stomach could scarcely have been diagnosed without inflation; and in the two others rectal inflation was of value, not only in proving the perforation, but in showing that a perforation low down in the sigmoid flexure had been overlooked after the operation was considered concluded. Mackie of Milwaukee,† Taylor of Philadelphia,‡ and a few others who have employed the method, have found it of value. The gas is contained in a rubber balloon, and in the tube connecting the balloon with rectum or stomach is a manometer to register the pressure exerted during insufflation. The parietal opening being made patulous, the gas escapes audibly, and may be ignited. The flame is easily extinguished by placing a wet sponge over it. Hydrogen gas is preferred on account of its low specific gravity, thus always rising to the surface, its harmless nature, and its being readily ignited. With most surgeons, the employment of the hydrogen test would probably be restricted to cases where shock was not severe, and where the probability was against perforation. The inflation test may fail; its failure is not definite contra-indication to operation. Also it may add to the danger through increase of shock and forcing of fæcal fluids through the intestinal wound into the general cavity.

Dulness on percussion, either in the track of the ball, or in

* *Phila. Med. News*, August 25th and Nov. 10th, 1888; *Trans. Amer. Med. Assoc.*, 1888; and *Journ. Amer. Med. Assoc.*, Aug. 30th, 1890.

† *Phila. Med. News*, June 9th, 1888.   ‡ *Ibid.*

the dependent portions of the abdomen, is, if present in marked degree, evidence of extravasation of fluids or blood. Localised dulness would usually be taken as indicating hæmorrhage: diffuse dulness, extravasation of visceral fluids. But either sign must be of rare occurrence, and where they do occur they might only indicate that certain portions of bowel are at that moment more full of fluid than other portions. The rapid occurrence of tympanites, too, which is most marked on the anterior abdominal surface, may leave the dependent portions relatively dull to percussion. Emphysema of the abdominal wall in the neighbourhood of the wound is occasionally observed, but it is rare, and it may occur without penetration of viscera.

The presence of blood in the urine indicates, according to the position of the wound, injury to kidney, ureter, or bladder. But extensive injury to any of these organs may exist without the appearance of hæmaturia.

Injury to nerves or spinal cord will show itself in paralysis of the supplied parts. Injury to vascular trunks is inferred from the absence of pulsation in the femoral vessels.

Shock is frequently mentioned as an invariable sequence of perforating wounds of the viscera. Experience has shown that it is an exceedingly variable symptom, being frequently marked in unimportant cutaneous wounds, while it may be completely absent in the worst cases of perforation. In some cases, it is nothing more than nerve-prostration from terror ; in others, it is produced by free hæmorrhage, or rapid extravasation of visceral fluids. In no case can its immediate occurrence be said to be indicative of visceral perforation. Further help may be derived from an observation of the condition, as to its increasing or diminishing in degree, and as to its capacity to be influenced by mental stimulus. It is sometimes observed on the battle-field that a man found in a condition of profound shock, on being told by the surgeon that he has received only a slight contusion on the abdomen, has his nervous vigour at once restored, and returns to the fighting. Reassurance may help to remove nerve-shock. True " abdominal shock " from extravasation of fluid into the cavity cannot thus be charmed away. It is probable, however,

that, in spite of many notable exceptions, perforation of any of the abdominal viscera would, in the majority of instances, be followed by shock more or less severe.

One of the most important symptoms is a feeling of nausea, frequently accompanied with vomiting. This is not common in false shock, while in a considerable number of cases of undoubted perforation it was present in greater or less degree. Our estimate of the value of this symptom is certainly not diminished by a knowledge of its import in other abdominal lesions.

MORTALITY.

Morton of Philadelphia,* Sir William MacCormac,† N. B. Carson ‡ of St. Louis, and Barker § of London, have compiled elaborate tables of all the cases of operations performed for abdominal injury. Morton's tables, including cases of shot-wound recorded up to the end of 1886, give 22 operations with 5 recoveries. MacCormac's tables, extending up to May, 1882, include 32 cases, with 7 recoveries, one (Pirogoff's) being doubtful. Carson's tables, extending to June, 1887, include 43 cases: of these, 13 recovered; one (Pirogoff's) was progressing favourably at the end of four days, and was then lost sight of. Barker's tables add 26 cases to MacCormac's 32, giving 58 cases altogether with 35 deaths. Of these 26, 16 recovered and 10 died, —a marked improvement on the earlier results. Coley up to 1890 has collected 165 operations with a general mortality of 67.2 per cent. Of these 81 were for wounds of the small intestine with 25 recoveries; 24 of the stomach with 6 recoveries; 36 of the colon with 12 recoveries; 19 of the liver with 8 recoveries; and 11 of the kidney with 1 recovery. Amongst the 81 cases of wounds of the small intestine there were no fewer than 439 perforations, or an average of 5.4 perforations for each case. It is a remarkable fact that in only 9 of the 165 cases did the surgeon fail to find all the perforations. Morton in 1889 had collected 110 cases of

* *Journ. Amer. Med. Assn.*, Feb. 26th, 1887.

† *Abd. Sect. for the Treatment of Extra-Peritoneal Injury.* Lond., 1887.

‡ *Journ. Amer. Med. Assn.*, Nov. 5th, 1887.

§ *Brit. Med. Journ.*, March 17th, 1888.

section for perforating gunshot-wounds, with 36 recoveries—a mortality of 62 per cent. The total mortality, considering the nature of the injuries, the usual condition of the patient when placed on the operating table, and the necessarily tentative nature of the earlier operations, cannot be regarded as other than exceedingly satisfactory.

INDICATIONS AND CONTRA-INDICATIONS TO OPERATION.

Of all penetrating gunshot-wounds of the abdomen, nearly eighty-eight per cent. are fatal. When involving the stomach or intestines, "these wounds may always be expected to cause death, generally from peritonitis following extravasation, or from very acute septicæmia." Otis* tells us that only six or seven unequivocal recoveries from shot-wounds of the stomach are known, fistulæ being left in two of them; while he doubts if there is even one "incontestable instance of recovery from wound of the small intestine." In shot-wounds of the large intestine the prognosis is more favourable; about 20 per cent. recovering, with or without stercoral fistula. Wound of the gall-bladder is almost certain to cause death from extravasation. Under the best palliative treatment, death almost inevitably takes place. Therefore, if a desperate remedy is ever admissible in a desperate disease, it certainly is so in gunshot-wounds of the abdominal viscera. Operation by abdominal section is certainly a desperate remedy, but it has already been proved to be far better than none.

The known tendencies of penetrating ball-wounds of the viscera being admitted, the indication to operate follows of necessity on proof of the receipt of injury. By operation alone can the parts be put into such a condition that spontaneous recovery is probable, or, it might almost be said, possible. By operation we can check hæmorrhage; we can prevent extravasation if it has not already taken place, and remove noxious fluids if it has taken place; and we can provide free drainage if

* P. S Conner, *Internat. Cyc. Surg.*, vol. ii., p. 193.

septic peritonitis has set in. A mere recapitulation of the anatomical conditions provides the indications for operation.

But contra-indications exist. Firstly, we must have regard to the condition of the patient. Profound collapse which is not due to hæmorrhage is a contra-indication of weight corresponding to the gravity of the condition. Such collapse existing a few hours after receipt of injury is not so unfavourable as when it has continued for a day or more. In the former case the vital powers are not so much exhausted, and are more susceptible to resuscitating influences; in the latter case diffuse peritonitis may be present, which demands a somewhat tedious manipulation during operation, and makes a prolonged call on the energies of the patient during cure. Undoubted and severe peritonitis existing on the second or third day is by most authorities recognised as a contra-indication. In such cases, it is improbable that the sites of perforation would be found; and if they were, that they could be dealt with without the production of excessive traumatism. There is little use in cleansing the cavity if it is to be at once refilled, and there is little use in looking for the perforations if they can neither be closed nor fixed in the wound, while there is a positive danger in adding to the risk from traumatism. In such cases the most that can be done is to make a small parietal opening with the help of local anæsthesia, and permit the discharge of the noxious fluids and secretions, giving the patient the benefit of the remote chance of spontaneous cure with intestinal fistula.

An important practical question is as to the best time for operation. In a general way, it may safely be said that operation should be performed as soon as possible after it has been ascertained that there is perforation of peritoneum. Coley's statistics show that of 39 cases operated upon within twelve hours 18 recovered, while of 22 operated upon after twelve hours only 5 recovered. The chance of recovery would thus seem to be greatly increased by early operation. Symptoms must not be waited for; they are often misleading when present, and their continued absence is compatible with the receipt of injuries which must inevitably lead to death. If there is much shock,

the operation may be put off while the patient is closely watched and treated for an improvement which would justify operation. The possibility of the shock being due to hæmorrhage must not be overlooked. In this, as in so many other conditions, nearly everything must be left to the educated judgment of the surgeon; it is impossible to provide specific or absolute rules for guidance.

OPERATIVE TREATMENT.

If the patient is feeble or collapsed, an enema containing brandy should be given before the anæsthetic is administered. The parietes must be thoroughly cleansed, and the pubic hair, if it lies near the seat of injury or operation, must be shaved. The perforated rubber sheet, if it can be used without encroaching on the field of operation, should be fixed in position.

The instruments are the ordinary ones in use for coeliotomy with the addition of four or more of Makins's intestinal clamps. At least a dozen of the round milliner's needles recommended for enterorraphy, ready threaded with silk of suitable size, are provided. Thick prepared catgut should be in readiness, in case it is necessary to close wounds in the solid viscera. A number of sponge-cloths and flat and round sponges are kept ready, in warm antiseptic lotion. A large fountain reservoir, with rubber tubing and glass nozzle attached for irrigation, is placed in a convenient situation some feet above the level of the patient. A receptacle placed under the operating table, for collecting the fluid which escapes from the abdomen during irrigation and trickles over the large macintosh, will be found convenient.

The Parietal Incision. — Nearly all writers on the subject recommend the median incision. MacCormac, Parkes, Nancrede, Bull, and Morton insist upon the median incision, and give numerous cogent reasons for their views. Morton says that in nearly all the successful operations the median incision was employed. Since he wrote, however, at least five successful operations through incisions not median have been recorded.

Professor McGraw of Detroit vigorously protested against the uniform wisdom of this plan; but his protests seem to have been ignored by subsequent writers.

There can be no doubt that, as affording most space for a general exploration of the whole cavity and its contained viscera, the median incision is best. In cases where the course of the ball has been across the middle line, entering at one side and passing towards the other; and in others where the ball, entering near the middle-line, passes either directly backwards, or in an uncertain direction, vertically or laterally, then the median incision is indicated. Also, in all cases where the course of the ball is unknown, the median incision is the best. On the other hand, there are cases where an incision not median is indicated. A ball injures only such organs as lie in its course. Reason and experiment combine to show that balls passing through the soft tissues of the abdomen pursue a course that is almost straight. If there is a deflection, it is in the great majority of cases in accordance with the law of equality of the angles of incidence and reflection. The erratic courses of balls sometimes met with occur in cases where the skin is perforated at a very oblique angle, and can rarely apply to gunshot wounds of the abdomen. It may be safely inferred that a ball passing through the abdominal cavity follows the course it had on perforating the parietes; if deviations take place after it has struck bones or hollow viscera, these do not influence the scheme of operation. Thus, in such a case as that of Barker,* where the ball entered three inches internal to the anterior iliac spine, the lateral incision which he adopted was better than a median incision could have been. A case of McGraw's, in which the colon only was wounded, is evidence in the same direction; and several similar cases might be quoted.

It is not, however, a question of mere convenience of examining viscera, but also of adding to traumatism. The whole length of the intestine and all the fixed viscera cannot be systematically examined with impunity. Only those fixed organs which lie in the course of the ball need be examined; and in the

* *Brit. Med. Journ.*, Nov. 26th, 1887.

case of the movable intestines, common sense must be our guide in deciding as to the extent to which examination must be carried. Thus, if a ball passes through the right lumbar region, perforating the ascending colon on its anterior and posterior aspects, there is no necessity for examining the stomach, or transverse and descending colon, or more of the small bowel than lies near to the seat of injury. It is unnecessary to multiply examples; they will at once suggest themselves. It is true that the intestines may move some distance away from the track of the ball, and this distance may be increased according to the length of time which has elapsed since the receipt of injury. But intestines can scarcely move from epigastric or umbilical regions to the bottom of the pelvis; or from the right lumbar region to the left. And the fixed organs cannot move at all. We need not overdo the certainty of proving integrity of viscera at the expense of increasing the patient's risks.

The line of incision must be guided by reasonable deductions from the indications as to the course of the bullet. To the operator the major premise in this course of reasoning must be the course of the ball through the parietes. I entirely fail to appreciate the force of the arguments so frequently urged against probing of the wound. Where a ball has passed, surely a probe may follow without much increase of danger. I should always probe the wound, using a very blunt instrument, which cannot be insinuated into the inter-muscular spaces; and this probe I should leave in the track of the ball if its presence were of the slightest assistance in showing the line of injury. To lay open the track is in most cases unnecessary.

The line of incision should be guided by a simple process of reasoning as to the inferred and probable course of the ball, deduced from the site of the aperture of entrance and the course of the ball. To the skilled operator (and no other should undertake these cases) it is a matter of absolute indifference where entrance into the abdominal cavity is made. The objections of increased hæmorrhage, and division of muscular planes, usually urged against incisions made not in the linea

alba or the linea semilunaris, are not for a moment to be considered against increased facility of access to abdominal organs in operations for visceral injury.

What is to be the exact line of incision it is impossible in general terms to indicate. In every case the inference should be that the organs injured lie in the line of the ball, as shown by the course it pursues through the parietes, and the incision should be made accordingly. It is probably true that the line of incision will in most cases fall to be made in the middle line; but in an important minority the incision will be guided according to the principles indicated. In general terms it may be said that the middle of the line of parietal incision should lie over an imaginary point situated midway between the point of the probe in the ball-track resting on the peritoneum and the opposite wall of the cavity.

The length of the incision must be regulated by the thickness of the parietes, the firmness and tension of the muscles, the degree of distension of the bowels, and the amount of injury probable or ascertained. It need be neither vertical nor transverse, but should be regulated in length and made in direction entirely, as the reasoning of the surgeon, based on the premises indicated, directs. Beyond this it is probably unnecessary to specify directions.

Examination of Cavity.—The parietes being incised to the length desired, the lips of the wound are kept apart by retractors in the hands of the assistant. The self-retaining retractors introduced by Maunsell will suit the purpose admirably, and do not require holding.

The end of the bullet-track where it strikes the peritoneum is first examined, to see that no hæmorrhage is going on, and to make finally certain as to the fact of perforation. The ragged, and perhaps foul, opening is cleansed with an antiseptic, and, if it is large, is at once closed by a continuous crossing stitch. Any blood-clot which obscures the field of operation is mopped up gently, without disturbing the intestines. A systematic examination of all the viscera which lie in or

near the track of the ball is now carried out. If hæmorrhage is going on, the source of it should at once be sought for before doing anything else. It must be remembered that manipulation may set up vermicular contraction of the intestines, leading to displacement of their wounds from the line of injury; therefore, any wound or serious contusion observed during the exploration for bleeding points should at once be grasped in catch-forceps, which are left attached. Again, when the bleeding point has been discovered, it may be temporarily secured by pressure-forceps while an opening in the bowel which is discharging fæces is being closed. No definite order of procedure can be laid down. The most urgent calls are attended to first : the less grave injuries, while they may be temporarily diminished by judicious placing of forceps or sponges, are left to the end. A rapid survey of all the parts is made when the dangerous hæmorrhage or abundant extravasation has been checked, and the full extent of the injuries inflicted is finally ascertained. We now proceed to the surgical repair of these injuries.

Repair of Injuries.—At this stage, if there has has been extravastion of visceral contents, I should recommend that abdominal irrigation should be commenced and continued while the closure of visceral wounds is being carried out. The irrigating fluid, if conducted over the macintosh into the receptacle provided, need not be in the way; it is cleansing the abdomen, and so saving time ; and, perhaps most important of all, if the fluid is used at a temperature of 105°, it will be found an excellent means of treating shock. The stream should be a gentle one, such as an elevation of the reservoir of a foot and a half above the patient would give. An excellent method of conveying the irrigating fluid into the abdomen for this operation would be to employ the long rubber double tubes now in use for washing out the stomach. As the parietal wound does not closely fit the tube, only a portion of the fluid would escape out of the evacuating tube ; but this is of small moment.

The assistant will meanwhile be looking after the forceps attached to the wounds of bowel or other organs, holding them

in a bunch at the position requiring least traction in the wound. This plan of operation is not that usually recommended. Surgeons hitherto have almost uniformly advised immediate and complete suture of an injury as soon as it is discovered. But this suturing is a tedious and irritating process, and during the carrying out of it the intestines may be acting violently, displacing other injured portions and adding to the amount of extravasation. The only advantage of immediate suturing is that no perforation is afterwards overlooked: forceps attached to the edges of the perforation, or the middle of the contusion, secure this advantage just as well.

Sponge-cloths are now arranged round the opening: the surgeon pulls one pair of forceps to the surface, and examines the wound in the intestine. The other forceps are now gathered together and laid between the folds of a cloth, while the assistant prepares to help the operator. The injured bowel is carefully examined, and the mode of treatment decided upon. A slight contusion may be left to its fate. A moderately severe contusion may be doubled inwards, and Lembert's suture or a continuous Dupuytren suture placed in the healthy bowel beyond it, so that if it does become gangrenous the slough will be discharged into the lumen of the gut, and cannot escape into the general cavity. In cases of perforation at the free border of the bowel, we may adopt simple closure after cleansing of the edges of the wound, or closure after resection of the bruised edges, as seems at the time most convenient and safe. Lembert's suture (see Enterorraphy) will, in the great majority of cases, be found the best. For a small perforation, a continuous suture will be found perfectly efficient. The direction of the line of suture would seem to be of little importance. Multiple perforations occupying a small piece of bowel may require a more extensive resection, up to complete removal of the whole calibre. This is carried out exactly after the manner described for Enterectomy and Enterorraphy, and need not again be described.

During these manipulations the bowel will be lying on a soft sponge-cloth placed by the side of the parietal wound. Usually no clamp will be required, the fingers of the assistant being

quite efficient. If resection is to be carried out, I should recommend the employment of Lane's clamps. During the operative proceeding, a sponge or two placed over the viscera will prevent their being extruded. A small space should be left by the side of the irrigating tube to permit the outflow of fluid.

A wound at the mesenteric border is a more serious affair. A wound passing through the mesentery close to the bowel, or through the mesenteric border of the bowel, will usually, by occlusion of the intestinal vessels, lead to gangrene of portions of intestine involved. For this injury the treatment must be resection of bowel, along with the perforated wound of the mesentery. If it be not necessary to remove a piece of mesentery that is actually wedge-shaped, the lines of incision should at least go well beyond the seat of injury. The wounds are united exactly as described for Enterorraphy.

Each wound after it is closed is thoroughly cleansed, and the bowel is returned to the cavity. When all the intestinal wounds discovered at the first examination have been closed, the bowels are pushed to one side, and kept there by a large sponge, while the underlying solid viscera are examined. If the site of lodgment of the ball can be detected, an attempt snould be made to remove it. Bleeding vessels are, of course, secured.

Perforations in the *stomach* are dealt with in the same way as in the intestine. A perforation in the posterior wall can be reached only after making an opening through the layers of the gastro-colic omentum. If it cannot be sutured by this route, it may be reached from the front after gastrotomy, as has been suggested for perforating ulcer of the stomach on its posterior aspect. In these cases extravasation of gastric contents nearly always takes place, and irrigation and cleansing will have to be specially thorough.

Wounds of the *omentum* are occasionally attended with free bleeding, which may form a large hæmatoma between its layers. In such a case complete amputation of the omentum above the site of injury would be the best treatment. A small perforation

without bleeding should be excised, to prevent the risks of gangrene, and the opening should be closed by a continuous suture.

Wounds of the *liver* are by no means necessarily fatal: Edler's elaborate tables* show that of uncomplicated cases of shot-wound only 39.1 per cent. died, while of all cases 55 per cent. died. The duration of cure was usually prolonged from the presence of foreign bodies in the wound, and particularly splinters of bone from the ribs: this fact suggests the propriety in such cases of seeking for foreign bodies, and removing them if found. Suppurative inflammation was the most frequent cause of death (37.5 per cent.); hæmorrhage was the cause in 20 per cent. of the cases. Therefore, cleansing of the wound should be as perfect as possible, and should be carried out, not only by means of irrigation with a soft catheter of small size introduced along the track of the wound, but also by friction with a small pledget of cotton rolled around the end of a probe and saturated with an antiseptic. Bleeding must be checked either by the insertion of deep catgut sutures, or by plugging the wound with a strip of antiseptic lint or gauze, the end of which is carried through the perforation in the parietes. Murphy, in a successful case, employed suture alone.

Wounds of the *spleen* cause death, according to Edler, almost invariably by hæmorrhage. Of uncomplicated cases, 65 per cent. died ; of all cases, 83.3 per cent. Suppuration is rare, and arises mostly from the presence of foreign matter. The friability of the splenic tissue renders closure of a gaping wound, so as to check hæmorrhage, difficult. Parkes, however, found that deeply placed sutures of catgut held fairly well. If the suture fails, plugging with lint or gauze must be employed. Should these measures fail, the organ must be removed. In all cases of serious injury to the spleen, primary removal is indicated; the results of removal for injury are far more favourable than for disease.

Shot-wounds of the *kidney* are not so dangerous as is generally supposed. According to Edler, death most frequently results

* Langenbeck's *Archiv. f. Klin Chir.*, Bd. xxxiv.

from pyæmia, accompanied with peritonitis and suppuration. Recovery is usually very tedious, on account of the frequent complication of urinary extravasation. Of uncomplicated shot-wounds of the kidney, 85 per cent., according to Edler, get well ; of complicated cases, only 16 per cent. ; and of all cases, 56 per cent. recover. If only 15 per cent. of cases of uncomplicated shot-wound of the kidney die, it is doubtful whether operation is ever indicated in this class, except on undoubted signs of hæmorrhage or peri-nephric or peritoneal suppuration. The complications of renal injuries are likely to be severe—on the right side, wounds of liver and colon ; on the left side, wounds of spleen and colon—and the results of operations are therefore not likely to be favourable. In cases of doubt as to the wisdom of removing the whole organ, or of the ability of the patient to bear the operation, the chances of successful issue may be increased by free drainage carried out through a wound made in the loin. In some cases bullets have been found embedded in the renal tissue.

Wounds of the *urinary bladder* are closed by Lembert's suture in the same way as wounds of the other hollow viscera. The whole subject of cystorraphy will be fully dealt with under the head of intra-abdominal rupture of that viscus.

Wounds of the *gall-bladder* are easily diagnosed from the presence of bile in the cavity. If the wound involves only the fundus, and is not large or lacerated, it may be closed at once by suture. If the wound traverses both sides of the bladder and the liver as well, then it may be best to remove the whole viscus. To reach the upper wound, it would be necessary to partly detach the bladder from the liver, and this detachment would predispose to gangrene. Therefore, in such a case, cholecystectomy would be the safest procedure.

Supposing now that the whole of the visceral wounds have been satisfactorily dealt with, and that the parts are in a condition in which repair is possible, a final cleansing of the cavity is carried out, and the wound is closed, with or without drainage as seems best. A larger nozzle may be put on to the irrigating

tube, and the reservoir is elevated a foot or two higher, so that a larger and more rapid stream is conveyed inside the abdomen. While the fingers move the intestines about, the stream is conducted successively to all parts of the cavity, and is not checked till it returns as clear as it went in. Then all superfluous fluid is pressed out, and a few large sponges with sponge-holders attached are placed in the abdominal hollows, and left there while the stitches are inserted. They are removed, with any free fluid that has been left, before the stitches are tied.

In some cases the state of the patient may be so grave that resection, or any prolonged operation of suturing, may not be permissible. In such cases the wounded bowel, resected or not as may seem best, is fixed in the wound, so as to produce an artificial anus. Temporary closure of the intestinal wounds in the parietal opening may always be carried out, so that the peritoneal cavity may be sealed off by plastic exudations before the artificial anus is made. This proceeding is carried out in the manner already described for enterotomy and enterectomy.

Drainage may or may not be carried out according to the opinion of the surgeon as to its expediency or necessity. In most cases it will be wise to drain.

Stab-Wounds of the Abdomen.

The whole subject of stab-wounds being in many respects similar to that of shot-wounds of the abdomen, it will be unnecessary to do more than specify the points of difference.

Here again we are indebted to Morton,* MacCormac,* and Gaston* for drawing up tables of recorded cases of operations. Morton collected 19 cases, including one by a splinter of wood; of these 12 recovered. MacCormac gives 18 cases, with 10 recoveries. Gaston's table, which most nearly brings the operations up to date, contains 28 cases, with 16 recoveries: 19 cases had wounds involving one or more of the viscera; of this number, 10 recovered and 9 died. Morton's most recent

* *Loc. cit.*

statistics (1889) give 79 cases, with 48 recoveries—a mortality of 39.24 per cent. About 30 more cases have since been recorded. A series of six brilliant operations are reported by Dalton * of St. Louis, who has up to date operated 23 times for penetrating stab-wounds of the abdomen, with 3 deaths and 20 recoveries. This must be regarded as a very satisfactory mortality, considering the nature of the injuries.

Any sharp instrument forced through the parietes may perforate hollow viscera. But its effects vary widely, according to the nature of the instrument. A stab with a bodkin or a stiletto has very different immediate results from a deep gash with a large broad-bladed sword. But the ultimate results may be the same. I have seen death take place in five days from suppurative peritonitis, caused by puncture of the intestine by a fine exploring needle ; and I have known of another case in which a triple wound in the intestinal coats, as broad as the jack-knife which caused it, was not fatal in so short a time. In a large wound there may be protrusion of viscera—an accident which may sometimes be fortunate, as exposing an intestinal wound, and permitting, to some extent at least, escape of its contents outside the abdomen. Every variety of wound may be caused by a diversity of instruments. A jagged piece of wood, the spike of a railing, or the prongs of a pitchfork, will each have its variety of wound, partially to be inferred from the character of the instrument.

Now, it has been found that stabbing wounds are by no means so uniformly fatal as perforations caused by bullets. The danger would seem, in such cases, to depend as much on the condition of the viscus as to fulness or emptiness, as on the amount of injury it has received. Through a wound of fair size, a viscus distended with fluid will at once empty itself into the peritoneum ; and, further, a distended viscus is more liable to be ruptured than an empty one. The rapidly-moving bullet goes straight through everything, full or empty ; while the comparatively slow-moving instrument, pushed by hand or penetrating after a fall, will push an empty viscus aside.

* *Journ. Am. Med. Assocn.*, Nov. 15, 1890.

The conditions vary according to the organ penetrated, just as they do in gunshot wounds. Cutting wounds have more blood effused, and death from hæmorrhage is more common in them than in other penetrating wounds.

Looking at the recorded cases of operation, we find that in several the manipulations included nothing more than cleansing of the abdominal cavity from blood-clot and suturing of the parietal wound. In Carson's case a liver-wound was sutured, and death took place on the fifth day from iodoform poisoning; the peritoneal cavity being found very nearly normal. In two cases excision of intestine had to be carried out: one died and one recovered. In nine cases suture of intestine or stomach was carried out: in one the spleen was excised; and in several various wounds of omentum, mesentery and other parts had to be dealt with.

Resection of the margins of the wound is not called for so frequently after stabbing as after gunshot injuries. In a clean-cut wound, simple suture without much inversion of margins will be efficient. Bleeding, being a more frequent and a more dangerous result of stab-wounds, requires correspondingly minute attention. In a greater number of cases than after shot-wounds, operation may be successfully carried out through the original stab-wound enlarged in whatever direction is most convenient.

As to indications for operation in stab-wounds of the abdomen, there is a very general consensus of opinion that every case of undoubted penetration of the abdomen should be at once treated by coeliotomy. The indication is only a little the less urgent if there is no perforation of viscera; cleansing of the cavity from blood-clot, and checking hæmorrhage, put the patient in a far more favourable condition for recovery than when these operations are not carried out. In any case, perforation of viscera cannot certainly be diagnosed till abdominal section has been performed.

AFTER-TREATMENT OF OPERATIONS FOR GUN-SHOT AND STAB-WOUNDS
OF THE ABDOMEN.

The first principle in the treatment of these cases is intestinal rest. If there are wounds of the stomach or upper portion of the small bowel, all food by the mouth must be withheld for from four to six days, and rectal feeding instituted. The first foods given by the mouth should be either dilute peptones or beef jellies, or peptonised milk. The patient should be kept as quiet as possible in bed; change of position should be made by extraneous help, and not by personal muscular effort. If opium is to be recommended anywhere in abdominal surgery, it should be in such cases as these which are frequently attended with considerable mental disturbance. It should be given as morphia, and by hypodermic injection.

When drainage has been employed either for incipient peritonitis or for a very abundant extravasation of intestinal contents, the management of the tube will demand considerable care and judgment. At frequent and stated intervals the cavity is emptied by the exhausting syringe, and the nature of the discharge observed. On the slightest evidence of the oncome of suppurative peritonitis, irrigation with a mild antiseptic (I should select boro-glyceride) should be carried out, and some of the fluid should be permitted to remain inside the cavity. The formation of intestinal adhesions, which is one of the chief dangers in acute peritonitis, is not so likely to occur if the intestines are kept floating in a mild watery fluid; and the risks of septic absorption are lessened by the presence of an antiseptic in the cavity. The irrigating process may be repeated with advantage every few hours. With a little judgment in the arrangement of the contrivances, it is possible to employ irrigation without disturbing the patient or soiling the bed-clothing. In such cases stimulants in small quantities must be added to the nourishing enemas, and the use of the rectal tube and the hot-water enema for the removal of gas will be called for.

If acute peritonitis develops soon after operation, and no drainage tube has been inserted, the best treatment will in most

cases be to at once insert the tube and commence irrigation with hot (105°—110°) antiseptic fluids. Several authorities in such cases recommend the employment of considerable doses of atropia, alone or combined with morphia. I should place more value on free stimulation by the rectum, frequent turpentine enemas and the use of the rectum tube. The employment of leeching in the earlier stages has been highly spoken of, and Leiter's cold-water tin coil is said to have given good results.

The parietal wound is treated exactly as in other abdominal operations.

Rupture of the Intestine.

History.

Pathological Anatomy.

Symptoms.

Diagnosis.

Treatment.

History.—Although only a very few operations have been performed for this condition, its extreme importance, and the preparedness of surgery to deal with it, will justify a somewhat detailed consideration. Our knowledge of the whole subject has recently been much advanced by the publication of a prize essay on " Contusion of the Abdomen, with Rupture of the Intestine," by B. F. Curtis of New York,[*] which is founded upon numerous experiments, and a careful and analytical study of 116 cases of recorded rupture of the intestines. MacCormac[†] has collected 13 cases of operation for rupture of the intestine, simple and complicated, without a single success. Croft of St. Thomas's Hospital[‡] has had two cases : the first recovered from the immediate effects of the operation, but died from the effects of a second operation performed a month later for the cure of the

[*] *Internat. Journ. Med. Sc.*, Oct., 1887.   [†] *Op. cit*
[‡] *Chir. Soc. Trans.*, vol. xxiii.

artificial anus which remained; the second made a perfect recovery at one operation. In Croft's paper there is a table of 14 cases, from which it appears that shock is the chief cause of death. Dunlap* records a successful case of resection and suture of the small intestine for rupture caused by tape-worm. Dalton† reports 3 cases of operation for rupture of the small intestine, with 2 recoveries.

Pathological Anatomy.—As a result of his experiments, Curtis came to the conclusion that the injury is not a true rupture, a bursting of the gut over its contents, but a contused and lacerated wound made by crushing between the contusing body and the bony parts. The danger of rupture was diminished by partial distension of the gut. The possibility of rupture from forcible impaction of the liquid contents against a fixed loop of bowel must not, however, be overlooked. Rupture of the duodenum would seem to take place in this way. I have seen two cases of rupture of the duodenum, caused, in one instance, by a fall on the back, and in another by a severe blow on the back; in neither was there fracture of spine, nor any injury in front.

The most common cause of the injury—in about 28 per cent. of all the cases—was found by Curtis to be the kick of a horse or a man. Next to this, and in about equal proportions, are run-over accidents, blows on the belly by weights, and falls on projecting points. Great velocity and small area of striking surfaces would seem to be most likely to cause rupture. In 113 cases, the relative frequency of parts injured was:— duodenum, 6 cases; jejunum, 44; ileum, 38; other portions of the small intestine, 21; and colon, 4. The danger of rupture was found to be greatest in those parts of the intestine which are most fixed, excluding the large intestine on account of its being sheltered.

The extent of the rupture varies considerably. In about a fifth of the cases the rupture extended either completely, or almost completely, across the bowel. In a tenth of the cases,

* *N.Y. Med. Journ.*, 1893, lvii., p. 166.   † *Journ. Amer. Med. Assocn.*

the ruptures were multiple. The size of rent most frequently observed was about an inch in length. There is a somewhat uncertain relation between the extent of injury and the violence of the blow, the more extensive injuries being caused by the more violent blows. This, however, in no way influences prognosis; for small ruptures are as certainly fatal as large ones. The mucous membrane, in the large majority of cases, was found everted and bulging through the peritoneal rupture.

Extravasation of intestinal contents is almost invariably found. Fæcal fluids were found in two-thirds of all Curtis's cases; and the existence of peritonitis in nearly all the others rendered it probable that extravasation of contents had taken place in these also. In two cases of complete rupture, the open ends were so entirely closed by muscular contraction, prolapse of the mucous membrane, and rapidly formed adhesions, that the bowel was actually found to be distended above the seat of rupture. In some of the cases, contusions of the gut were found, in addition to the rupture.

The most serious complication is injury, either as laceration or as contusion, to the mesentery. A laceration of the mesentery may cause death in a few minutes from hæmorrhage; and contusion, followed by hæmostasis in its vessels, may result in gangrene of the bowel. In 16 per cent. of Curtis's cases there was either laceration or contusion of the mesentery, and these were among the most rapidly fatal of all. Of 15 cases of laceration of the mesentery, all but three were fatal within twenty-four hours. The importance of these observations, from a practical point of view, is self-evident.

Symptoms.—The symptoms may be conveniently considered as those immediately following the injury and those occurring subsequently. The symptoms first observed are usually shock, restlessness, nausea and vomiting, retention of urine, constipation, and local pain and tenderness. In the great majority of cases, shock is present in a marked degree. In a few, however, it is described as absent. A certain amount of restlessness is usually noted in the early stages, but a great many cases do not

OPERATION.

The operation to be described is choledochotomy ; or chole-docholithotomy as first deliberately planned and performed after diagnosis of stone in the common duct by Courvoisier in the beginning of 1890. Stones had been removed from the common duct before this; in 1889 I myself by a combination of cutting and crushing had done so; but the credit of introducing the elaborated operation belongs chiefly to Courvoisier.

In competition with the operation of cutting there is the operation of crushing. Now this may often be easily done between the finger and thumb through the walls of the duct, and if we could be certain that the débris would be washed away it would be the best operation of all. Fenger condemns it as it "leaves débris, some of which may remain in a pouch in the duct, increase in size, and as the stone is always a bacterial depôt, may cause inflammation of the wall or even cholangitis." If it were possible to wash out the fragments by aspiration as in litholapaxy, or even after incision of the duodenal wall (as done by McBurney) through the duct itself as it enters the duodenum, I think the operation of crushing, by avoiding the necessity of making a large wound in the duct, would be the best. In a second case of my own, operated upon in the Bristol Infirmary in 1894, a large incision was made over an impacted stone over half an inch in diameter; it fel to pieces on being caught in forceps, and I greatly regret that I did not crush it, for at death (from intra-abdominal hæmorrhage on the fourth day) the duct was found to be quite patulous towards the duodenum.

In competition with choledochotomy is cholecystenterostomy, which is not a cure properly speaking, but a make-shift ; but which may, in certain cases, be done to cure the patient of cholæmia as a preliminary to the radical proceeding. Un-fortunately the gall-bladder is nearly always collapsed and there is no certainty that the cystic duct is patent. In cases of tumour where the gall-bladder is often dilated, cholecysten-terostomy is probably the best operation to select. In two cases

where the stone was impacted in the diverticulum of Vater an incision was made through the duodenal wall to reach it.

The parietal incision must be a free one, as ample space is essential. Either one long vertical incision through the outer fibres of the rectus, or an angular incision one limb of which skirts the rib-margin and the other follows the fibres of the external oblique, should be selected. With either of these incisions ventral hernia is not likely to take place, as few or no muscular fibres are divided transversely.

We must expect, on entering the abdomen, to find general matting together of organs in the region of the gall-bladder; and the separation or division of these must be done with care and deliberation. The gall-bladder, often small and shrivelled, is first localised; and the surgeon works downward from it, keeping close to the liver. The orifice of the foramen of Winslow is felt for; the forefinger is inserted, and between it and the thumb the anterior border of it in which lies the duct is palpated between the liver and the duodenum. A large stone will easily be felt; a small stone or a floating stone may be felt with the greatest difficulty, or, as has several times happened in the hands of highly-skilled surgeons, may not be felt at all. If the stone is mobile, and it is pushed towards the liver, it may slip into the hepatic duct, when it is not easily returned.

When the stone has been felt and located, preparations are made for its removal.

The field of operation is firstly as far as possible isolated by flat sponges laid between intestines and liver, one being tucked well under the liver. These are watched and kept in position by the fingers of one hand of an assistant. The liver margin is pulled upwards, so as to make the organ rotate and expose its under surface as freely as possible. The assistant at the same time sees that the margins of the parietal wound are kept as widely apart as possible. If the parietes are muscular, a Maunsell's self-retaining retractor may be found useful. A good light is essential: an electric lamp and reflector should be in readiness.

The stone being steadied in the duct, an incision is made

directly over it in the direction of the duct, and the stone is either pressed or scooped out. Bile usually flows out of the incision. In movable or floating stone, Fenger advises that the stone be pushed towards the duodenum and that the incision in the duct be made at its duodenal end, because then there is no chance of wounding the vena portæ.

The stone being removed, the duct should be probed upwards and downwards to feel for another possible stone or stones, and to see that the passages are clear. If the duct is greatly dilated, the little finger may be inserted to explore.

The difficult part of the operation, the closure of the common duct, is now undertaken. For insertion of the sutures, Mayo Robson recommends the use of a small rectangular cleft-palate needle. Other surgeons have used small curved smooth needles held in a needle holder. A double row of sutures is placed; the inner row passing through the external walls of the duct but not penetrating the mucosa, the outer row penetrating the peritoneal covering and picking up the outer coats after Lembert's method. The sutures are not tied till all are inserted, the long ends being employed to help in pulling forward and steadying the incision during the insertion of the stitches. A continuous re-inforcing suture may be placed at any weak point. Imperfect suturing may be proved by the escape of bile after the duct is liberated.

Drainage is always advisable. The best drainage would probably be got by Morison's method, through a stab-incision made below the kidney. Fenger recommends a rubber drain passed down to the wound in the duct, and gauze drains inserted, one above and the other below the drainage-tube. The parietal wound is closed in the usual way.

The after-treatment needs no special description.

Section XI.

OPERATIONS ON THE SPLEEN.

SUMMARY.

OPERATIONS ON THE SPLEEN.

THE operations performed on the spleen are Splenotomy, or incision into the organ for the evacuation of fluid ; Splenectomy, or removal of the spleen; and Splenopexy, or fixation of a movable spleen.

SURGICAL ANATOMY.

The spleen, lying in the left hypochondriac region between the cardiac end of the stomach and the under surface of the diaphragm, is roughly moulded to fit the space in which it lies; being concave on the stomachic aspect and convex on the diaphragmatic. On the concave inner surface, nearer to the posterior than the anterior border, is the vertical groove of the

hilum, pierced by apertures for vessels and nerves. The perito-
neum which invests the spleen is reflected at the hilum to enclose
the splenic vessels and nerves and the vasa brevia, and is known
as the gastro-splenic omentum. Surgically, this is the pedicle of
the spleen. (Fig. 223.) Between the upper end of the spleen and the diaphragm passes another double peri-toneal layer known as the suspensory ligament of the spleen. The exter-nal surface of the spleen, in contact with the diaphragm, is described as lying in contact with the ninth, tenth, and eleventh ribs. The internal surface, in its anterior portions, is in relation with the cardia of the stomach — behind, with the left crus of the diaphragm and the left supra-renal capsule; and below, with the tail of the pancreas. Its rela-

FIG. 223. (WEISSE.)

*Drawing to show the Vessels in the Hilum of
the Spleen.*

1, 2. Vessels penetrating the Spleen at the Superior, and
4, the Inferior Extremities of the Hilum. 3, 5, 7. Gastric
Branches — Vasa Brevia. 6. Gastro-epiploica Sinistra.
Anterior Border to right, Superior Border above. Artery
above, Vein below.

tions with the stomach are liable to be disturbed by the movements
of that organ. As to the margin of the spleen : at the top, where
the suspensory ligament is given off, it is blunt and rounded ; the
lower extremity is pointed, and normally lies over the junction of
the transverse with the descending colon : the posterior margin is

broad and rounded, and is connected with the left kidney by loose areolar fibres. The average dimensions of the spleen in the adult are: five inches in length, three or four in breadth, and from an inch to an inch and a half in thickness. Its weight is about seven ounces.

The structures in the gastro-splenic omentum, venous and arterial, which go to form the pedicle in splenectomy are of importance. The splenic artery, the largest branch of the cœliac axis, pursues a tortuous course behind the upper border of the pancreas from the aorta to the spleen. In its course it gives off small branches to the pancreas; near its termination it gives off the gastro-epiploica sinistra; and it finally breaks up into a number of branches near the hilum, most of which enter it, but a few of which—the vasa brevia—turn backwards to the stomach. The vasa brevia, from five to seven in number, issue partly from the trunk and partly from the branches of the splenic artery. If deligation is made close to the spleen, they may escape. The terminal branches are five, six, or more in number, and vary greatly in length and size. If the branches are short, and they enter the spleen over a considerable area, it would be impossible to include all of them in one or even in two ligatures.

The splenic vein is a very large vessel, returning blood, not only from the spleen and the pancreas, but also from the duodenum, a great part of the stomach and omentum, the descending colon, and part of the rectum. Its splenic branches correspond to those of the artery; the vein itself lies behind the pancreas, below the artery.

But little padding of fatty or areolar tissue surrounds the splenic vessels at the hilum. As it would usually be unsafe to include all the splenic branches in one ligature, it is fortunate that they may readily be isolated and ligatured separately.

Splenotomy.

This operation, done for abscess, may be dismissed in very few words. According to Nolen,* only five cases of recovery after

* Abstr. in *Brit. Med. Journ.*, April 19th, 1894.

operation for abscess on the spleen are recorded. To these might be added a sixth case in the service of a colleague at the Bristol Infirmary, and a seventh by Sendler.*

The abscess is usually found either pointing or adherent to the parietes, and the operation simply consists of evacuation and drainage. Occasionally sloughs of splenic tissue are found in the abscess sac. The diagnosis is not usually accurately made till the operation.

Splenectomy.

History.
Conditions for which Operation Performed.
Mortality and Indications.
Operation Described.

History.—The practice of removing the spleen is probably of some antiquity. It was done for purposes sufficiently vague, being supposed to improve the wind of the individual (as in the Texan runners), or to ameliorate his moral nature. Dionis, in his second demonstration of surgical operations (1733), speaks of a class or sect of surgeons which sprang into notoriety about 1700 from their operations of removing the milt or spleen—" unmilting " the proceeding was called. He does not spare them : " They looked on this part as useless and noxious, because (perhaps) unacquainted with its uses ; and, in pursuit of this opinion, they prescribe the making an incision in the left hypochondrium, through which they take out the milt, and after having made a ligature of the vessels, boldly cut it off. This operation being performed on some dogs which did not thereupon die on the spot, they thence deduced and proclaimed the advantages which would accrue to mankind by it. . . . No longer mention is made of these cruel operations, which, owing their existence to some crude brains, found a sepulture in that of their inventors."

For prolapse of the spleen through a parietal wound splen-

* *Amer. Journ. Med. Sc.*, March, 1894.

ectomy was performed more than 200 years ago. Such an operation was that of Matthias, performed in 1678 :* and a few others are on record.†

Many experiments have been made on the lower animals by removing the spleen. In comparatively recent times, Blundell operated at least seven times on rabbits; two recovering permanently, and two temporarily. The whole subject has been experimentally gone into, with all the aids of modern science, by numerous physiologists and surgeons, and notably by Tizzoni, Mosler,‡ Zesas, § and Winogradoff. || These experiments prove that the spleen is not essential to the life of animals; and that if it is removed, its functions are taken up by vicarious lymphatic organs which increase in size, and by bone-marrow.

For disease, the first operation, according to Collier,¶ was performed by Zaccarelli in 1549, and was successful. The second operation, by Ferrerius in 1711, seems to have been the removal of a rudimentary spleen from an abscess tending to point; it was also successful. Both these operations have been discredited. Quittenbaum in 1826, and Küchler in 1855, each removed an enlarged spleen; the patients in each case dying in a few hours, of hæmorrhage. Spencer Wells operated for simple hypertrophy in 1865; his patient lived six days, and died either of thrombosis or of blood-poisoning—possibly of both. Péan in 1867, operating for enlarged and cystic spleen, had the first success of modern times: from his case we may date the introduction of splenectomy into modern surgery.

Conditions for which Splenectomy may be Performed.—Nearly all authorities are agreed that the extirpation of leucocythæmic spleen is an unjustifiable operation. Therefore, although the operation has been performed some twenty times, leucocythæmic enlarge-

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* See Simon, *Die Extirpation der Milz am Menschen. Giessen.*, 1857.

† See Morris, *Internat. Syst. of Surg.*, vol. v., " Injuries and Diseases of the Abdomen."

‡ *Deutsch. med. Woch.*, 1884, No. 22.   § Langenbeck's *Archiv.*, bd. xxviii., p. 815.

|| *Revue de Chir.*, 1885, p. 318; quoted from *Vratch*, 1883, Nos. 6 and 7,

¶ *Lancet*, 1882, i., p. 219.

ment is excluded from the conditions justifying operation. The following conditions remain:

(1) Injury or Prolapse.

(2) Certain cases of movable spleen.

(3) Simple hypertrophy, with or without cirrhosis.

(4) Sarcoma or lympho-sarcoma in the early stages.

(5) Cysts.

(6) Hydatid disease.

In the case of abscess, as well as of cysts, simple and hydatid, splenotomy, or incision of the spleen with suture of the wound to the parietes and drainage, should first be instituted. The treatment is carried out on exactly the same lines as for similar diseases of the liver or kidney, and need not be again detailed. Should splenotomy fail to cure, splenectomy may be indicated. Splenic abscess becomes early adherent to the parietes, and its treatment may be nothing more than incision and drainage. From such an abscess I have seen a piece of splenic tissue, as large as an orange, removed as a slough.

Wounds of the spleen can only be inferred with a presumption of certainty from the site of the injury and the presence of abdominal hæmorrhage. Later on, peritonitis, splenitis, and abscess may supervene, and induce symptoms calling for abdominal section, after which the condition is diagnosed with certainty. In such cases, the state of the patient is the indication to operate; splenic wounds are by no means always fatal. Prolapse of the spleen through a parietal wound is easily diagnosed: in certain cases, the organ may be returned; in others, only the protruding part need be removed.

Movable spleen, according to Engel,* is associated with pregnancy, depending on causes similar to those assigned by Landau to movable kidney. It is not free from danger to life. Reported cases show that a movable spleen tends to fall into the left iliac fossa; that the organ is enlarged; that its pedicle may become twisted, causing occlusion of the vessels; and that it has a tendency to contract adhesions in its abnormal situation, and there undergo degenerative changes, or even gangrene.

* Centralbl. f. Gynäk., 1886, V.

Serious symptoms may be caused by dragging on the stomach through the gastro-splenic ligament. The operation of splenopexy, to be described, would now be considered preferable to splenectomy for such a condition.

Simple hypertrophy, with and without cirrhosis, has, in at least fourteen cases, been given as the reason for removal. It is difficult from the histories to estimate the influence of malarial disease in causing the enlargement for which operation was performed. The diagnosis is simply that of enlarged spleen, already described : in most cases, however, the operation was performed in the belief that the disease was something else.

Billroth* successfully removed the spleen for lympho-sarcoma. The tumour had existed for seven years : there was no leukæmia. It would be impossible in the early stages to diagnose malignant disease from simple enlargement. When the disease is so far advanced as to cause adhesions to neighbouring organs, the operation is unjustifiable. Indeed, from what we know of the behaviour of malignant disease of the spleen, we should infer that the operation was only very exceptionally admissible.

Considering the rarity of cysts of the spleen, it is somewhat remarkable that the organ should have been three times removed for that disease. All the operations were successful. Thornton's first operation—the first successful one in England—was for splenic cyst. The diagnosis cannot with certainty be made from renal cyst. Puncture, or incision with drainage, might be tried before removing the organ. As, however, the cystic disease is usually associated with hypertrophy of the splenic tissue, it is probable that the cyst-formation is only part of a more general disease. In none of the operations was the condition diagnosed till the abdominal cavity was entered.

For hydatid disease, puncture has been successfully performed by Wilde,† and probably by others. Koeberlé has extirpated the organ for hydatid disease followed by a sanious discharge. The diagnosis must always be uncertain.

Appreciation and Mortality. Indications and Contra-indications.— Collier's elaborate tables comprise 29 cases of splenectomy ; 13

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* *Lancet*, June 7th, 1884.   † *Deutsche Archiv.*, viii., 116.

being for diseases not associated with leucocythæmia—of these 8 recovered; 16 for leucocythæmic hypertrophy—all these died. So far, there would appear to have been performed only one successful operation for leucocythæmic spleen—that of Franzolini of Turin —and his case is doubtful.* Ashhurst † has collected 43 splenectomies for disease, with 31 deaths; and 21 operations for injury or prolapse—all successful. Nussbaum, however, of 26 cases for traumatic causes, found that only 16 recovered. Gilson,‡ in a careful review of the whole subject, quotes 18 operations for injury, with recovery in all; and 37 for disease, with 29 deaths and 8 recoveries. Podrez of Kharkoff estimates the total mortality as 73 per cent. Mollière § has tabulated 28 cases of coelio-splenectomy for disease, and 11 cases of splenectomy for wound, with results according with the above. Wright of Manchester ‖ has collected and tabulated 62 cases of splenectomy. Of these, 22 were for leukæmia—all were fatal; 23 were for simple hypertrophy—15 died; 7 were for malarial disease—5 recovered; and 3 for cystic disease—all recovered. Asch ¶ has collected 90 cases: of these 51 were successful (14 were for wandering spleen). Statistics, up to April, 1890, have been collected by Dr. M. Howard Fussell of the University of Pennsylvania. They include a total of 105 splenectomies, with 57 recoveries and 48 deaths. Of these operations 28 were for simple hypertrophy, with 19 deaths; 24 for leukæmia, with 23 deaths; 26 for accidents, with 1 death; 16 for floating spleen, with 1 death; 5 for cysts of the spleen, with 1 death; and the rest for rupture, suppuration, pernicious anæmia, and sarcoma. Spanton ** has collected 25 cases of operation for leucocythæmic spleen with 24 deaths, and 75 of non-leucocythæmic spleen with 28 deaths. The latest statistics are those of Dr. Richard Douglas,†† who has collected a list of 194 splenectomies. For leucocythæmic spleen there were 36

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* *Wien. med. Woch.*, 1883, No. 20.   † *Internat. Encyc. Surg.*, vol. v., p. 1103.
‡ *Rev. de Chir.*, April 10th, 1885.
§ *Dict. Encyc. des Sc. Med.*, 1883, Art. "Splenotomie."
‖ *Med. Chron.*, Dec., 1888.   ¶ Abstr. in *Internat. Journ. Med. Sc.*, Nov., 1888.
** *Brit. Med. Journ.*, Nov. 2 and Nov. 9, 1895.
†† *Journ. Amer. Med. Assoc.*, April 25, 1896.

operations with 31 deaths; for simple hypertrophy, 59 operations with 25 deaths; for neoplasms, 5 operations with 3 deaths; for hydatids, 6 operations with 2 deaths; for wounds, 43 operations with 11 deaths.

A dissection of the figures according to the causes of operation shows that the removal of prolapsed or wounded spleen is not only a justifiable but a successful operation; and that the removal of leucocythæmic spleen, even if it gave promise of a cure of the disease, is negatived by its almost uniform fatality. Experience has shown that in leucocythæmia there is a marked tendency to hæmorrhage after operations of any sort; and this tendency, in such an operation as splenectomy where hæmorrhage is always a chief risk, is enough to forbid it. Besides, there is no reasonable ground for inferring that removal of the spleen would have any influence for good on the general disease. Splenectomy in leucocythæmia is, as Bryant puts it, "physiologically unsound and surgically unsafe": it ought, therefore, to be abandoned.

For disease not attended with leucocythæmia, the operation is at least justifiable. For undue mobility the operation has been most successful; for cystic disease the operation has been very successful; while for such conditions as lympho-sarcoma, simple hypertrophy, hypertrophy with cirrhosis, hydatids and abscess, the failures have about equalled the successes.

The present position of splenectomy, therefore, is something like the following: Operations for leucocythæmic spleen are unjustifiable. Operations for traumatic lesions are justifiable and safe. For movable spleen, excision ought not to be carried out till less severe measures, such as mechanical support or operative fixation, have been tried and found ineffectual. For cysts, the spleen may be removed with a fair chance of success; but puncture or incision, with drainage, ought to have a trial first. In the early stages of malignant disease the operation is justifiable. In the rare cases of primary hypertrophy, the operation is permissible if the disease is attended with danger or serious discomfort.

THE OPERATION OF SPLENECTOMY.

The incision in most of the operations has been made in the middle line. This, no doubt, is a result of erroneous diagnosis, and not of operative election. A lateral incision along the outer edge of the left rectus would probably be the most convenient. It would certainly be so in all cases not attended with great enlargement. Küchler and Wells made the entrance through the linea semilunaris; Bryant, a little farther to the outside. In prolapse, the wound may or may not require enlargement.

The tumour being fully exposed, all adhesions are divided and ligatured. It is gently delivered, lower extremity first. If the tissue is not very friable, the use of the myoma screw will be of advantage. Sponges are packed inside the cavity; and the parietes are depressed as much as possible by an assistant, to prevent traction on the pedicle. The tumour must be handled with extreme gentleness; and the most scrupulous care must be given to the avoidance of injury to the vessels in the pedicle, and even to dragging on them, which has been found to produce alarming symptoms of shock.

The success or failure of the operation may be truthfully said to depend on the treatment of the pedicle. Death from hæmorrhage after a few hours has frequently occurred, after what seemed to be the most perfect deligation at the hands of our most skilled operators. A small artery slips from the encircling ligature (as in Thornton's second case); or a ligature slips during straining; or bleeding may commence from the moment the patient begins to rally from the shock. It is clear, therefore, that our surgical technique in this part of the operation is by no means perfect.

Morris* recommends that, before cutting away the tumour, a clamp should be placed around the pedicle, and that it should afterwards be ligatured in two or more parts with strong twisted silk or whipcord. Thornton, in a successful operation, tied the pedicle in two locked ligatures and added a separate ligature

* *Internat. Encyc. Surg.*, vol. v., p. 1104.

monograph,* and to Morris's article on "Injuries and Diseases of the Abdomen," in the *International Cyclopædia of Surgery*.† With special reference to rupture of the liver and its consequences, as a collection either of pus or bile, Briddon ‡ writes in a very suggestive manner, and his suggestions are supported by a very successful case. Dalton,§ in a case of rupture of the liver on its under surface where he could not insert sutures, had a success after packing the rent with strips of gauze, the end of each strip being carried through the parietal opening. Burckhardt, ‖ in describing his case of successful operation for hæmorrhage from a wound of the liver produced by a stab from a butcher's knife, deals with the whole subject in a very instructive manner.

* *Arch. f. klin. Chir.* 1887. xxxiv. † Vol. v., p. 875.
‡ *N. Y. Med. Journ.*, Jan. 31st, 1885.
§ Abstr. in *Brit. Med. Journ.*, Nov. 1st, 1890. ‖ *Centralbl. f. Chir.*, No. 5.

Section XV.

OPERATIONS FOR PERITONITIS AND ITS EFFECTS.

SUMMARY.
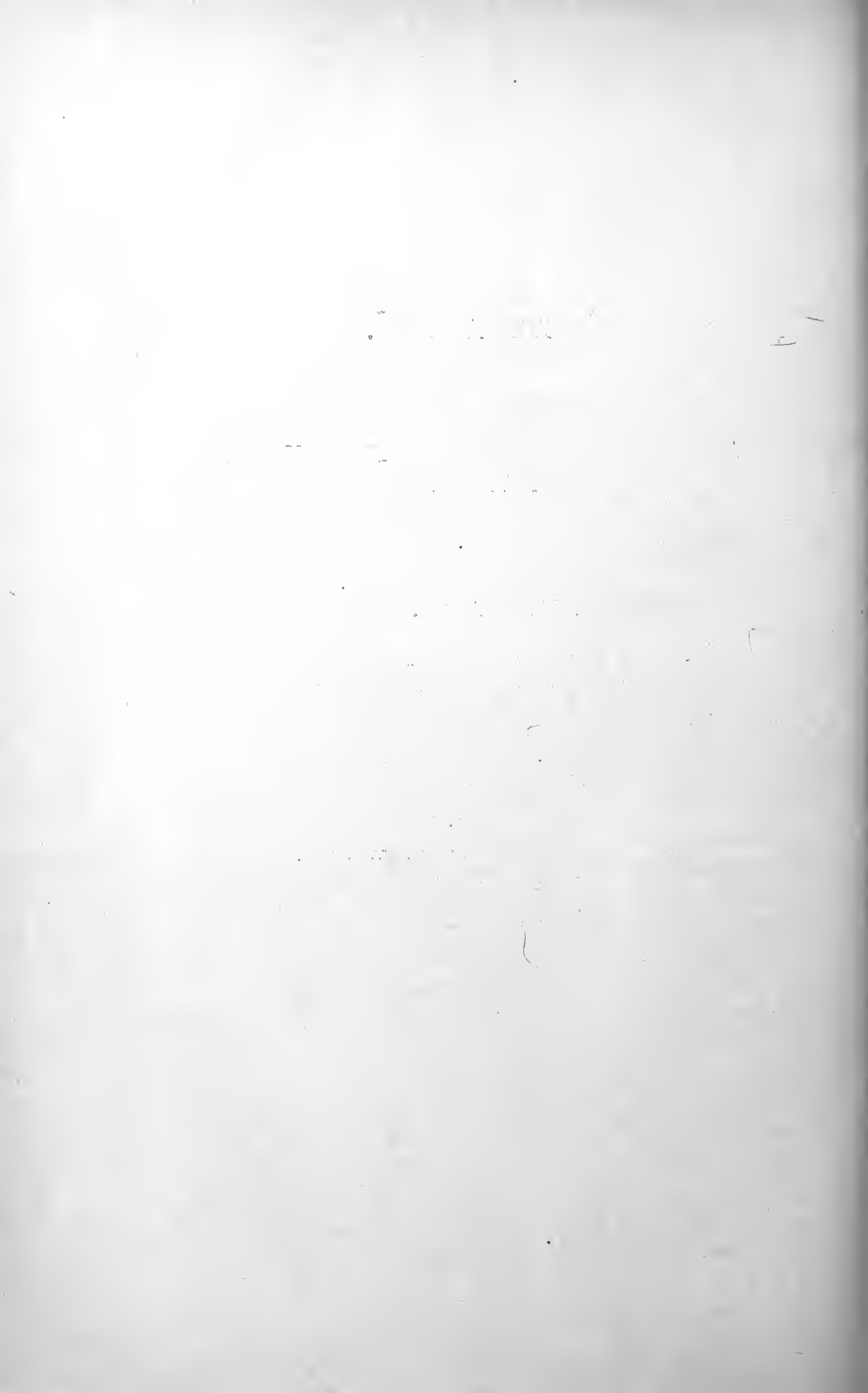
OPERATIONS FOR PERITONITIS AND ITS EFFECTS.

To discuss the whole question of peritonitis would take us beyond the limits set to this work. It is necessary, however, to consider such results of peritonitis as demand surgical intervention for their cure, and to inquire when and in what degree the progress of certain peritoneal inflammations may be checked or modified by surgical operation. This is done as shortly as possible, and with avoidance of unessential and disputed questions.

At the outset it is necessary to be clear as to the meaning of the terms employed. What is meant by peritonitis? Some surgeons would withhold the term from all inflammations not caused by micro-organisms, asserting that there is no inflammation which is not septic. If this view is held, then we must

remodel our whole conception of the process of inflammation. The very place where the student is told to go for the study of the process of inflammation is this peritoneum as represented by the mesentery of the frog when irritated by some proceeding not necessarily septic. I prefer to retain the old view that this is inflammation, and that aseptic injury to the peritoneum results in real peritonitis.

Then there is the question whether inflammation is a beneficent or a malignant process—something to be assisted or something to be resisted. Again, it is a question of definition of terms. It depends on whether the process of phagocytosis, as it is called, or the heaping up of barriers of protective germ-destroying cells, is regarded as belonging to inflammation or to repair. It is, perhaps, best regarded as a process of protection going hand-in-hand with the inflammation, always leading towards repair, and, if it conquers, securing ultimate healing. But attempts at destruction and at repair go hand in hand—or, more correctly, side by side—in every inflammation, and it may be quite impossible to say in any given case whether repair or destruction is the more important. A case which is mostly destructive may still show feeble attempts at repair ; and another which is mainly protective will have in it some elements of destruction. Therefore, there can be no harm in speaking of either such case as inflammatory.

Now, a patient may die from want of phagocytosis, by direct septic absorption, as much as by excessive phagocytosis, by formation of abscess and bursting of it into the cavity. A patient may die as readily from direct absorption of septic material through the peritoneum without the appearance of a drop of pus or any evidence of peritoneal inflammation, as after diffusion of the products of pus-producing organisms with the secondary effects which they produce. We have a threefold influence, or rather a trifid line of causation : firstly, nerve influence ; secondly, septic absorption ; and, thirdly, the results of phagocytosis, amongst which abscess production and diffusion must be reckoned. To take a view of peritonitis as wide as this, with its threefold origin, seems to me to be

the most scientific. It may be possible to say that one case with no gross evidence of peritonitis is septic entirely; or that another with diffusion of pus or contents of hollow viscera and peritoneal injection or plastic exudation is true peritonitis; or that a third with much extravasation of gas and no signs of true peritonitis, is nerve-shock. This may theoretically be possible, but, practically, it will rarely be possible to isolate the influences and give to each their true value.

That nerve influence plays a large and important part in the systemic results of inflammation of the peritoneum is universally admitted. Even if we could ignore the anatomical and physiological importance of the semilunar ganglion and its satellites in the abdomen, clinical experience would still demand something more than mere traumatism or mere septicism in explanation of the results produced. The extravasation of a few ounces of fluid into the peritoneal cavity is like a blow in the pit of the stomach, instantaneous in its results, and produces its effects before inflammation or septic absorption can have taken place. And extravasation of gas is worse, if possible. Like Dr. Malcolm* and others, I would ascribe to nerve influence a large share in the causation of death from every variety of peritonitis.

Practically, we may view peritonitis from three aspects. Firstly, from the point of view of simple traumatism, as from rough handling and exposure to air; secondly, where the peritoneum acts as an absorbent of septic material diffused over it; and, thirdly, where there has been raised a protective barrier against septic absorption, usually with pus-production as a coincident result. In all of them we have to reckon with the influence of nerve-shock, and this seems to be greatest where there is a sudden incursion of foreign matter, liquid or gaseous, into the cavity.

Now, it has been necessary to consider the results of peritonitis from most of these points of view already. Traumatic peritonitis such as always results from severe operative handling of organs covered by peritoneum has already

* *Med. Soc. Trans.*, 1893, xvi. p. 188.

been considered in the general section devoted to abdominal operations and in special places where it seemed worthy of notice.

Septic or absorptive peritonitis, with its universally concomitant shock, has, where possible, been placed in its proper position under the organ at fault, and handled simply as one of the effects of the lesion. It will be found, for instance, under the Stomach, as produced by perforating gastric ulcer; under the Intestines, as caused by perforating ulcer of the duodenum, and by perforation of the vermiform appendix. As caused by rupture of any of the hollow viscera by injury, it is described in the section devoted thereto. From the purely scientific point of view, there can be no doubt that this is the best way to regard peritonitis, to place it as subsidiary to the primary lesion which produced it; practically, this has been done as far as possible. There remain, however, for consideration certain varieties of peritonitis, attended with suppuration mostly, which cannot accurately be traced to their original causation; and certain others which appear to originate actually in the peritoneum. These and their effects are considered in this Section. Here, also, it may be convenient to call attention to the treatment of peritonitic adhesions.

CLASSIFICATION OF PERITONITIS.

No complete and satisfactory classification of peritonitis is possible until we have a full knowledge of its causation. I have already said that I consider the exclusion of every influence which is not septic from the category of cause as being open to various objections. Firstly, I consider that, unless we change our definition and conception of inflammation, we must include traumatism of every sort which is not associated with the importation of septic influences. Secondly, I think that we ought to include sudden extravasation of an aseptic fluid, such as that contained in a simple parovarian cyst, as a cause of peritonitis. A third form of causation is complex and might be exemplified by diffusion of the contents of a full bladder or a

full intestine: we call it peritonitis; possibly it is as much auto-intoxication added to general nerve-shock as inflammation of the peritoneum. A fourth variety undoubtedly depends on infection from micro-organisms, and is most frequently followed by the formatiom of pus.

The following classification attempts to place and bring together these various methods of causation:—

PERITONITIS.

I. *Simple Peritonitis.*
    (1) *Traumatic.*
        (a) From operation.
        (b) From injury through intact parietes.
        (c) From intestinal entanglement or strangulation.
    (2) *Diffusive.*
        From extravasation of aseptic fluids.

II. *Septic Peritonitis.*
    (1) *From pyogenic micro-organisms.*
        (a) From the intestines.
        (b) From the female genital organs.
        (c) From hospital or operative sources.
    (2) *From tubercular bacilli.*
    (3) *From mixed causes.*

III. *Specific Peritonitis.*
        Gouty, rheumatic, syphilitic, alcoholic, congenital.

These varieties of peritonitis may now be shortly considered in detail.

Simple Peritonitis.—This is the variety of inflammation from which we teach our students to study the whole process of inflammation. It is not septic, nor is it associated with pus-formation. The exudates, cellular and plastic, become organised or they are absorbed; and the worst effects are loss of endothelial covering with agglutination of surfaces by fibrous adhesions or the formation of fluid collections inside adhesions. Such an inflammation does not spread: it is limited to the area of injury.

Neighbouring parts may become involved through becoming adherent to the inflamed district; thus a piece of bowel which has become inflamed is liable to become adherent to any contiguous bowel or other organ.

As arising from operation, our familiarity with the process of aseptic peritonitis has bred for it a certain contempt. A slight degree of it scarcely disturbs the process of cure; a great amount or a great severity of it is always serious. The denudation of parietal peritoneum, the separation of many coils of intestine from a tumour, the manipulations necessary for the suture of torn organs, result in an amount of traumatism which is always followed by local and general disturbance. The general disturbance is soon over ; it lasts one or two days at most if the patient is going to survive. The local disturbance results at first in paralysis of the bowels with passive accumulation of gas and intestinal fluids; later on there is physical retardation of intestinal movements, through the intestinal walls becoming agglutinated.

As arising from injury through the parietes, from a run-over accident or a kick or blow, we may get a local peritonitis with or without extravasation of blood. Rupture of hollow viscera imports septicism and would not be included. I believe that many of those localised collections of sero-sanguineous fluid which so often follow injury to the abdomen are examples of traumatic peritonitis—a chronic hydro-peritoneum, like chronic hydrops articuli started by local tissue injury. If there has been extravasation of blood and formation of clot, the natural changes in the clot would partly account for the condition. If the clot becomes gradually absorbed, we hear no more of it. If it becomes liquefied, it may, with the help of serous exudates, form a tumour which may require to be emptied. Such a tumour is exactly the same as we find in the tissues elsewhere and goes through similar changes. It is found between the layers of any part of the mesentery, and also free in the abdomen encapsuled in a peritonitic cyst or in the lesser cavity.

The peritonitis found associated with strangulated hernia is usually aseptic, but not always so. The fluids found in a

hernial sac and in the general cavity, as a result of the irritative peritonitis set up by strangulation, are no doubt identical. It is now known that through inflamed or irritated bowel the bacterium coli commune may escape and exert virulent action amongst the inflammatory exudates. Fortunately this result is by no means universal.

Peritonitis, not always of a slight character, may be set up by a sudden diffusion, through rupture of its containing sac, of quantities of aseptic fluid. I have operated on a patient with papillomatous disease of the broad ligament in whom repeated ruptures of the cysts were always followed by severe attacks of peritonitis : the results at operation were only too evident in the general matting of all the peritoneal surfaces. I have known very serious illness result from peritonitis caused by rupture of a small parovarian cyst. Wounds of the gall-bladder may be followed by extravasation of enormous quantities of biliary fluid into the abdomen ; grave illness is always to be expected ; death often results. The peritonitis which follows the extravasation of healthy urine must in the first instance be aseptic ; it is always severe and serious. In these cases of extravasation of fluids into the cavity the elements of shock and of autotoxis must be added to the effect of simple peritoneal inflammation or irritation.

Septic peritonitis is by far the most important variety. The origin of the micro-organisms may be as wide as operative surgery, and owns special seats in the intestines as well. There is now no doubt, thanks to the investigations of Tavel and Lanz and many other observers, that the colon bacillus and its neighbours and family may penetrate the walls of gut which is inflamed or diseased, and get into the general cavity. Here it sets up a virulent peritonitis which may be local or general ; and if local, results in the formation of peritoneal abscess. Possibly abscess would always form if the patient lived long enough ; death, where the diffusion of septic matters is very extensive, usually occurs before suppuration supervenes. How far absorption of the bacterial products influences the fatal

result, it is impossible to say in this or any other form of septic poisoning. Many of these patients, as Treves * in his excellent monogram on Peritonitis points out, seem to die of poisoning rather than of inflammation.

The female generative organs provide prolific sources of peritonitis. The Fallopian tubes may contain pus with several varieties of micro-organisms : rupture or gradual extension of such an abscess produces septic peritonitis. From the uterus organisms introduced by the operating surgeon may reach the peritoneal cavity through the Fallopian tubes. The streptococcus usually associated with puerperal fever may produce its havoc in the broad ligaments, in the areolar tissue around the uterus, or in the general cavity. Glandular abscess in the groin, connected with gonorrhœa, may burrow extensively in the sub-peritoneal connective tissues, and its causative bacteria may penetrate the peritoneum.

From hospital or operative sources, in the air or on the hands or instruments, or from imperfectly purified skin, bacteria may be conveyed into the peritoneal cavity and set up septic peritonitis. This variety, which used to be the chief cause of death after all abdominal operations, is now fortunately preventable, and is usually prevented. It is prevented only by scrupulous and never-tiring care, and occasionally it will succeed in attacking a patient in spite of us. Any variety of pathogenic or pyogenic organism may be found in septic operative peritonitis, but the streptococcus is most frequently detected.

Tubercular peritonitis is a variety of septic peritonitis by itself, and will receive separate consideration. That it originates in the tubercle bacillus, and has certain results in formation of cheesy products, destruction of tissue and formation of cystic and purulent collections, is all that need be said here.

Peritonitis from mixed causes would be represented in that set up around a slow leakage of the contents of the bowel, which is not permitted to become diffuse through the heaping up

* *Peritonitis.* The Lettsomian Lectures for 1894.

of masses of phagocytes. A small abscess may form in the middle of the bulk of inflammatory new material; more frequently only a few drops of mucoid fluid are found around some small perforation in the bowel, and there is no proper suppuration. These masses of inflammatory new growth may attain to enormous dimensions, becoming practically tumours; probably, as I have argued elsewhere,* these represent those solid tumours of the abdomen which are supposed to spontaneously disappear. Since recording the three cases on which the above-mentioned paper was founded, I have met with a fourth connected with the appendix vermiformis, which was long under the observation of Dr. Evan Jones of Aberdare, and which fully bore out the arguments adduced. Phagocytic as distinguished from purulent peritonitis might properly distinguish this variety.

Specific Peritonitis may be given as a name to cases of the disease which are of doubtful origin, but are probably connected with some peculiarity of diathesis. I believe that we have a rheumatic peritonitis. I have seen and helped in the treatment of two such cases with peritoneal effusion in which anti-rheumatic remedies resulted in cure. On an anæmic girl in the Bristol Infirmary I recently operated for symptoms of grave disease in the upper abdomen, which might have been caused by perforating gastric ulcer. A spongeful or two of clear fluid was found in the cavity and nothing else. She was put on anti-rheumatic remedies, improvement set in from the time of operation, and cure followed. Syphilis and gout are said to originate peritonitis. Cancer of the viscera sometimes sets up true peritonitis, as apart from ascites. My friend Dr. Michell Clarke tells me that he has seen at least two cases of death from peritonitis with no other apparent cause than cancer in the stomach, which showed no signs of perforation. Other cases are met with—some of which die and some recover —which can be placed in no recognised category; such cases if fully understood would probably turn out to be septic.

* *Trans. Roy. Med.-Chir. Soc. Lond.*, lxxvii., p. 139.

SYMPTOMS.

The symptomatology of peritonitis is as varied as the disease. The differences, however, between diffuse fulminating peritonitis, chronic localised peritoneal abscess, and aseptic operative peritoneal inflammation are too wide to permit of any useful generalised description of symptoms. It would indeed be difficult to point out one single defining attribute of peritonitis which might at the same time be described as a symptom. Elevation of temperature certainly could not so be described; the very worst cases of septic peritonitis have either no increase of body-heat, or have positive diminution thereof. Nor can pain be described as a symptom: some of the worst cases of puerperal peritonitis are associated with little or no pain. Vomiting—a marked symptom in most cases—may be quite absent in the very worst cases as in the slightest. Constipation is usually present, often insuperable; in other cases there is diarrhœa. Distension of the abdomen from meteorism is one of the most constant of all the symptoms; but sometimes, and in the very worst cases, it never appears. And yet peritonitis is nearly always diagnosed; certainly it is rarely overlooked. Probably it would be found that the general appearance and condition of the patient, his look, his pulse, his general behaviour on the sick-bed, would go further with the trained clinician towards settling the diagnosis than any number of set rules built up on symptoms.

It is curious to observe how nearly all varieties of peritonitis which are going to prove fatal show a great identity of symptoms towards the end. A case of septic absorption with few or no signs of peritoneal inflammation, and whose course is run in a day or two, may at the end be, as regards symptoms, indistinguishable from a case of operation-peritonitis with abundant exudation of lymph, great injection of peritoneal surfaces, and which may have been going on for a week. The condition is graphically described by Treves* thus: "There is about the patient who is dying of peritonitis every suggestion of a poisoned man. He lies back in bed prostrate, with gaunt

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* *Loc. cit.*, p. 8.

cheeks and sunken eyes. There is a look of unceasing anxiousness in his face and a sense of hopeless unquiet in his movements. The hands, which wander with pathetic restlessness over the bedclothes, are cold and damp. The tongue is that of a man who is dying of thirst. There is constant vomiting. The breathing is laboured and accompanied with faint sighs and groans, and the countenance is ashen and livid. Such a picture makes a reality of the metaphor of 'the shadow of death.' So far as the aspect of the patient goes, he might be dying from snake-bite or from the poison of cholera, while there is little to suggest an inflammation so intense as to be ending fatally in a few distressful days."

This is how they all die, and the similitude to poisoning is probably more than a resemblance—it may be the thing itself. Of the rapidly fatal variety of peritonitis, autotoxis is almost certainly the ultimate as well as the prime cause of death. In cases beginning as traumatic, it is just possible that the process of peritoneal inflammation permits the exit of toxic intestinal contents to be absorbed into the system. This would be quite in harmony with what has been proved in strangulated bowel, and can scarcely be denied for general peritonitis.

The general symptomatology of peritonitis may be described under the heads of vomiting, tympanites, pain, constipation, fever, and constitutional disturbance, including nervous and circulatory phenomena.

Vomiting is on all hands admitted to be the most important and the most constant single concomitant of peritonitis. The vomiting is not often profuse as in strangulation of bowel, but is rather of the nature of constant eructations of gas and belching of fluid. The patient will retch several times, and then turning his head to one side will eject an ounce or two of fluid, rest for a few moments, and then repeat it.

This goes on with weary iteration hour after hour, but the nausea continues and relief never comes. At the end the desire to vomit cannot overcome the desire to be at rest, and the worn-out patient vomits no more. The stomach is distended to its utmost, the diaphragm scarcely moves, the respiration ceases,

and the patient dies almost in asphyxia. Towards the end, if the case has been of some duration, the vomited fluids may be fæcal; at the beginning, and frequently throughout, the fluids vomited may be clear or bile-stained mucus, running on to the condition known as coffee-ground.

Vomiting is usually at its worst in cases originating in perforation of the viscera; in chronic or sub-acute cases, and particularly in those associated with abscess formation, it is not so urgent. In cases of puerperal peritonitis vomiting may or may not be a marked symptom. I have seen it almost the only symptom in one fatal case; and in another, more rapidly fatal, it was scarcely present at all. In septic operation-peritonitis it is always present, often to an extreme degree. In simple peritonitis I have thought that it varies directly as the amount of meteorism; if the intestines can be emptied the vomiting will disappear.

Tympanites, meteorism, or gaseous distension of the intestines is nearly always present in peritonitis, and usually to a marked degree. In the worst cases of septic peritonitis, and especially in puerperal cases, it may not exist. In those cases associated with exudation of lymph glueing the intestines together, meteorism is always present. So in all those associated with strangulation or obstruction of bowel we expect to find it marked. Local tympanites is found round a local focus of inflammation; the bowels adherent around an abscess are always tympanitic.

It is clear, therefore, that blocking of the lumen of the gut is not the sole cause of meteorism, nor is paralysis with or without inflammation. Gases are locally produced by some means not fully understood; and their production goes on in spite of great increase of pressure. When the intestines are once over-distended they cannot pass the gas onwards. The explanation of this is probably manifold, but I think it is certain that kink-ing of the over-distended gut with the production of infolded valves is to be reckoned amongst the causes. It is certainly the only cause which, thus far, we have been able to remove by operation, and therefore is of chief interest to us in practice.

The appearance of an abdomen in which the bowels are distended with gas varies considerably. In a powerful, muscular man the distension is slight but the tension is extreme. There is no visible or palpable isolation of intestinal coils, the parietes are hard and board-like, and the whole abdomen sounds and feels like a drum. In a thin female with lax parietes, and who has borne children, there is enormous distension but little tension. The bowels are tense and visible and palpable as individual coils through the parietes. It would seem in the former case as if the gaseous pressure were kept up by the parietes, in the latter by the intestines. The strain in the muscular man is borne by the parietes; in the woman with lax parietes the strain falls first on the intestines.

The degree of distension varies again according to the duration of the case. It takes time to distend the normal abdominal parietes. Tension may arise to an extreme degree in a few hours in one case with an abdomen not much distended; after days, in another, there may be enormous distension with little tension. From the symptomatic point of view the observation of these points is of importance. The degree of meteorism is to be measured as much by the pressure it exerts as by the distension it produces.

Where the individual coils are visible or palpable through the parietes, signs of importance may be observed. If the coils never move or contract, but lie passively distended at one point, we may infer complete paralysis and almost certainly virulent inflammation. If, on the other hand, even if there is extreme distension, there is active movement in the bowels, a more hopeful prognosis with or without operation may always be given. During these movements various sounds of splashing or gurgling may be heard all over the room or by the stethoscope —their value here is chiefly in prognosis: in obstruction from mechanical causes they have another value in diagnosis as well.

Pain is a symptom of uncertain value. Some of the worst cases have no pain, although there may be much general distress; and some of the least severe cases have most pain. Generally speaking, it may be admitted that pain is in inverse

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ratio to the severity of the case, but the exceptions are striking. Thus, the pain following a sudden extravasation of gastric fluids is intense, and the peritonitis which supervenes is amongst the most fatal. Local tenderness on pressure indicates concentration of the mischief, and may be regarded as a favourable symptom. General tenderness on pressure, inability to bear even the weight of the bedclothes, is frequently observed. But, on the other hand, there are cases where pressure is grateful, and where a firm binder or a heavy water-bottle positively gives comfort.

The "tormina" of the "iliac passion" were described as being found around the navel. So, at first, are most peritonitic pains, except perhaps the very first shock of pain that follows the perforation, and which is referred to the seat of perforation. But soon this is forgotten in the general pain, which is worst in the mid-abdomen. If the patient survives the first onset, the attention may again be forced to a special point where the pain is always severe and is gradually getting worse. These points should be closely investigated; they are of great importance to the surgeon as helping to locate the seat of mischief.

Constipation, up to complete obstruction, is the rule in peritonitis. But there are exceptions. Treves in a collection of 100 cases of peritonitis from the London Hospital found the bowels classed as "loose" in 28 instances. This would, I think, be found an unusually high proportion. Diarrhœa, in my experience, is found most frequently in cases associated with local suppuration. I have never seen it in diffuse peritonitis. Paresis of intestinal muscle in inflammation spreading to it is in harmony with all we know concerning inflammation elsewhere; if there is diarrhœa, we might infer a healthy or merely irritated condition of some portion of the intestinal tract below the seat of inflammation. If there is marked inflammation of the mucous membrane there will be discharge of liquids and mucus, and this may induce a passive discharge analogous to diarrhœa.

Active intestinal peristalsis, even if associated with diarrhœa, is universally regarded as a favourable sign. With the motions

are discharged quantities of the distending gases, and meteorism is thus averted or diminished, to the great advantage of the patient. This fact has had an outcome in the treatment of peritonitis by purgatives which has been already discussed (p. 140).

The value of the symptom of constipation is often nullified by the administration of opiates to relieve pain. Some cases of peritonitis from the beginning show symptoms as if they were examples of obstruction; then they will probably have had purgatives. The fact of constipation is, therefore, not always to be relied upon as a symptom of peritonitis, any more than its absence or even positive diarrhœa.

Pyrexia.—It may truly be said that the presence or absence of fever is no indication for or against the existence of peritonitis. No symptom is more variable than this. The very worst cases of peritonitis may have a normal or subnormal temperature; a slight degree of peritonitis of an aseptic character may be followed by a sharp febrile reaction. It would certainly be nearer the truth to say that some elevation of temperature bespeaks a favourable course to the peritonitis, than that a low temperature indicates an unfavourable prognosis; but neither statement is more than loosely true.

The temperature is probably kept down by shock. The patient has no reactionary or rallying power in him; the influences which lead to pyrexia are nullified by those which follow profound constitutional shock. And shock is the most fatal of all influences: so that we may fear an elevation of temperature in peritonitis less than a depression.

Systemic Disturbances.—The presence of peritonitis involves in the individual a profound general disturbance, chiefly expressed in the nervous and the circulatory systems. Much of this disturbance may be traced to the influence of the sympathetic nervous system. The abdomen has more than its share of sympathetic nerve-centres, the chief of them all, the solar plexus, being placed close to what is, in most cases, the seat of disease.

Local nervous disturbances may be observed. In some

cases there is a sort of tonic spasm of the abdominal muscles; they are as rigid as boards: in others there is a marked increase of reflex, the slightest touch or tap on the parietes bringing on a spasm of muscular contraction which may be very painful. In subacute or chronic peritonitis I have often noted and pointed out a permanent increase of sensitiveness to reflex contraction, and therefore in all cases the abdominal muscular reflexes are tested by sharply scraping the skin with the finger-nail or by flicking.

A good deal of the fixity of the parietes is owing to voluntary effort, and is not reflex or spasmodic. The patient soon finds out that abdominal movements are painful, and he checks them. Usually the abdominal muscles become relaxed during anæsthesia, but sometimes they do not.

Profound nerve-shock is the first and most alarming symptom in all cases of severe peritonitis; and even in mild cases some degree of shock is, for a time at least, to be expected. The heart's action is at once affected, becoming rapid and feeble. Rapidity of pulse-beat without interference with its regularity is characteristic of peritonitis. The pulse-rate soon runs up to 120 or 140, being often quite countable up to this stage; but soon the pulse-beat loses in strength, becoming in bad cases little more than a feeble continuous flicker which cannot be counted. This is the so-called "abdominal pulse," and its existence augurs ill for the recovery of the patient. In such a case the circulation is imperfectly carried on, and coldness and duskiness of the extremities supervene.

With the nerve-shock in every case of peritonitis there is great thirst. Practically every operation involving exposure of the peritoneal cavity is associated with thirst; this, indeed, may be the only disagreeable incident during recovery. Ingestion of liquids by the mouth relieves it only a little; injection of fluid by the rectum relieves it more. In a bad case of peritonitis the thirst may be positive torture. It is not necessarily associated with loss of bodily fluids through vomiting, although this would, of course, aggravate it.

In every case of peritonitis, septic or aseptic, there is

always diminution of the secretion of urine. Sometimes this exists to an extreme degree, only eight or ten ounces being secreted in the twenty-four hours.

<div align="center">TREATMENT.</div>

The treatment of peritonitis must be regulated by the causation. To lay down a form of treatment for the disease, peritonitis, would be as wrong scientifically as it would be useless practically. Some cases, on the instant of diagnosis, must be treated by operation. Others will probably recover by palliative or medicinal measures varied according to the peculiarities of the case and its progress. Others after palliative treatment develop conditions for which operation is the only resource. The whole treatment depends on the causation of the disease : when this is diagnosed a consistent line of treatment may be prescribed suitable for every case.

Following the classification laid down, the lines of treatment would be broadly as follows :

<div align="center">SIMPLE PERITONITIS.</div>

Traumatic, from Surgical Operation.—This has already been discussed at page 140. The most important single items in the treatment here are, in my opinion, to keep the bowels acting, to encourage the passage of flatus, and to frequently change the position of the patient.

Injury from blows on the parietes may be attended with bruising of the bowel or with extravasation of blood; purgation, there-fore, is here contra-indicated. As resulting in encysted collections of fluid, the treatment is simple evacuation and drainage.

The peritonitis from *intestinal entanglement* or *strangulation* is as nothing compared with the cause which produces it. This is dealt with under Coeliotomy for obstruction.

In the variety of peritonitis resulting from sudden *extravasa-tion of aseptic fluids* the treatment will depend on the nature of the fluid. A ruptured hydatid cyst should for obvious reasons be treated by coeliotomy and abdominal cleansing. A ruptured broad ligament or parovarian cyst or hydrosalpinx may be left

alone.   If there is any suspicion of the presence of papillary growths, the tumour should be removed at once.   Rupture of any receptacle for secreted fluids, such as gall-bladder or urinary bladder, should be treated by immediate operation.   All these operations will be found described in their proper sections.

SEPTIC PERITONITIS.

In all cases where septic micro-organisms are set free in the general abdominal cavity operation is indicated.   Where abscess forms, from whatever source the pyogenic cocci have entered, operation is indicated.   This operation should always fulfil evacuation and provide for drainage.   It should also, wherever possible, remove the cause.   The treatment of peritoneal abscess remains to be considered in this section.

Tubercular peritonitis is a disease *sui generis*, and will here be separately considered.

Peritonitis associated with phagocytosis need have nothing special said about it ; and those ill-understood varieties of peritonitis which depend on diathesis are treated by means adapted to remove the cause.

MEDICAL TREATMENT OF PERITONITIS.

The medicinal or palliative treatment of a case of peritonitis which is not operated upon may here be shortly considered. This may be regarded also as the after-treatment of cases operated upon.

As to posture : the patient of course is treated in bed, in the recumbent position.   Usually he prefers to lie supine, with the shoulders raised and the knees pulled up or resting on a pillow.   I am doubtful whether he should be kept supine : I think that there are advantages in occasional lateral decubitus. By turning the patient on the side and drawing the knees up, the passage of flatus is rendered easier.   Change of position also prevents intestinal stasis.   The fluid-laden bowels gravitate into the pelvic and lumbar hollows, rest there and tend to become adherent.   If the patient is turned on one side, the laden coils slowly fall to the opposite side, and so prevent

stagnation and encourage peristalsis. If there is septic fluid in one of the hollows which we wish to keep localised, this might be a reason for keeping the patient supine; but such a case should be treated at once by operation.

If the patient is turned on the side, the belly should be supported by a pillow to prevent all sense of strain. Warm fomentations often give comfort and may be frequently applied. The bodily warmth generally should be maintained and added to.

As to drugs to be given, there is neither an extensive nor a satisfactory choice. It is needless to recapitulate the old arguments for and against opium and purgatives, nor will an attempt be made to elaborate the antagonism between the two. It will probably be admitted that *quâ* peritonitis opium can do no good, but may do harm ; while as soothing pain and preventing restlessness it may constitutionally do good. Purgatives, on the other hand, *if they act*, undoubtedly do the peritonitis good ; their action perhaps tends to weaken the patient. If the purgatives fail to act, they do much harm by increasing the secretion of intestinal fluids and so add to the general distension. There is a physiologically opportune moment for the administration of each drug, but it is no easy matter to decide when this arrives. When there is much intestinal distension and the coats are paralysed, purgatives by mouth will probably fail to act and may aggravate the trouble. In such a case I would rely rather on purgative enemata given rather sharply and in large amount. Various purgative drugs have been administered in this way, but nothing is superior to soap and turpentine. In that post-operative condition which has been well-named "pseudo-ileus," purgatives may be administered more freely, but always they should be encouraged to act by enemata.

One never administers opium in a case of peritonitis without a feeling akin to despair. The poor fidgetty, neurotic creature who cannot bear pain or deprivation of sleep without getting frantic or delirious must have opium, which, while aggravating one risk, lessens another and greater one. We are treating the patient and not the disease, and it is impossible to fight against this necessity sometimes. Opium is sometimes said to do good

by keeping the intestines at rest.   In peritonitis one great element of danger is this very intestinal rest ; the secret of recovery is to keep the bowels moving both in contraction and in bulk.   Rest is undoubtedly good for inflammation as inflammation, but we cannot always give an inflamed organ rest.   We can rest an inflamed ankle, for life is not thereby endangered ; but we cannot rest an inflamed lung or intestine. It is good for the patient to expectorate in bronchitis, as it is good for him to evacuate the intestines in peritonitis.

As to belladonna, I can say little that is favourable.   I think I have seen it do good, and I am sure I have seen it do harm. Personally, I have given it up entirely.

As to food and drink, we can rarely rely on administration by the stomach.   Even if there is no vomiting, the food is rarely absorbed, and seems to have little nutrient value.   If there is vomiting, food by mouth is not only useless but harmful, in that it simply adds to the weary work of the patient in rejecting it.   Our reliance must be placed on rectal feeding.   It is a good rule, at once on the diagnosis of peritonitis, to begin and systematically carry out the administration every four, five, or six hours of rectal foods and stimulants.   Most fortunately, in these cases both patient and rectum seem peculiarly tolerant of rectal alimentation.   The modes of rectal feeding have already been described (p. 142) and need not be recapitulated. I would simply re-assert my belief in the value of alcohol administered in the enemas.   It dulls sensitiveness and promotes drowsiness, and thereby replaces opium ; and it improves the action of the heart, the one organ which is the first to fail and which it is most important to keep going.   Drink is best given by the enema also, as a pint of tepid water or milk and water an hour before the next enema is due.   At least one "thirst" enema is given in the day ; but occasionally it may be given in large amount, in hopes that it may cause an action of the bowels.   If it does not, much of it will be absorbed and thirst will be relieved.

Purulent Collections in the Upper Abdomen.

Sub-phrenic Abscess

Causation.
Anatomical Conditions.
Symptoms.
Operation.

Suppurative peritonitis in the upper abdomen is often known as sub-phrenic abscess. The only defining attribute is, that it lies under the diaphragm and in contiguity with it ; it may, however, pass through the diaphragm and partly overlie it. The lower boundary of the abscess may vary almost indefinitely. The contents also may not be pure pus, but may consist chiefly of fluids ·escaping from the stomach or the intestine, and gas is frequently present. The last fact led Leyden, to whom we are chiefly indebted for our knowledge of the condition, to name the condition " Pyo-pneumothorax sub-phrenicus." The name " sub-phrenic abscess," being fairly accurate and well known, is here employed. It is a clinical and not a scientific name, however ; it is used as " pelvic abscess " is used, to group together for purposes of diagnosis and treatment a class of cases having varied origin. The community is no more than the name indicates, one of locality purely.

In one, and the most important point of view, its origin from perforating gastric ulcer, sub-phrenic abscess has already been considered. Until we have as complete knowledge of the other conditions which may cause it, we must group them together and give them a generalised study.

Causation.—The actual causes of sub-phrenic abscess include the following :—

> Perforation of the stomach—
>> From ulcer.
>> From cancer.
>> From injury.
>
> Perforating ulcer of the duodenum.
> Ulcer of the transverse colon.
> Perforation of the vermiform appendix.
> Pneumonia.
> Pyo-thorax.
> Hepatic abscess.
> Splenic abscess and injury.
> Disease, abscess and injury of the pancreas.
> Nephric and peri-nephric abscess.
> Injury to the upper abdomen.
> Pott's disease of the spine.
> Disease of the female generative organs.

This, it will be seen, provides a sufficiently varied causation. Broadly speaking, the chief causes are either perforation of a hollow viscus, or extension of suppuration from neighbouring organs. The typical causation, which also provides the majority of actual cases, is perforation of the stomach; the abscess is then intra-peritoneal. Upward burrowing of pus is best seen in nephric abscess, and downward extension in pyo-thorax; the abscess is then often retro-peritoneal. But there are exceptions to this rule. Perforations of hollow viscera may provide retro-peritoneal sub-phrenic abscess, as in perforation of the appendix or of the ascending or descending colon. And bursting of an abscess in a solid organ surrounded by peritoneum —liver or spleen—would nearly always be intra-peritoneal.

The individual causes may be studied. Perforating gastric ulcer has already been fully described (p. 554) and need not further be dwelt upon. It provides more than half of all the cases.

Perforation in cancerous disease of the stomach is a rare cause; about one in twenty have this origin.

A few cases apparently originating in injury have been recorded by Fagge* and others.

Perforation of a duodenal ulcer is given as the cause in about six per cent. of all the cases.

Perforating ulcer of the transverse colon, and particularly at the hepatic flexure, has been reported as a cause in a few cases. Perforating stercoral ulcer (p. 784) and suppurating appendicitis (p. 756) may produce retro-peritoneal burrowing of pus, which becomes fully sub-phrenic. Most cases of pyo-pneumothorax from perforation of the diaphragm have this origin.

Hepatic abscess does not often form a sub-phrenic collection of pus, but usually perforates directly after formation of adhesions to any contiguous part, such as bowel, diaphragm or parietes. Some writers, however, assert that hepatic abscess is a not infrequent cause of localised sub-phrenic abscess. A few cases of diffusion of hepatic abscess into the peritoneal cavity have been described.

Pneumonia and pyo-thorax are rare but undoubted causes. The septic infection travels downwards through the diaphragm and forms a centre of development in the upper abdomen.

Abscess originating in the pancreas if it perforated the peritoneum would in the first place fill the lesser cavity. Localised collections of fluid not purulent, filling the lesser cavity, probably often originate in injury to the pancreas. This has already been discussed under "Pancreatic cysts." If the peritoneum is not perforated, suppuration in the pancreas would produce a true retro-peritoneal sub-phrenic abscess.

Splenic abscess is very rare, and tends rather to form adhesions to the parietes. But several cases of complicated abscess in the upper abdomen have been traced to apparent gangrene of part of the splenic tissue.

In spinal disease suppuration fortunately tends to gravitate towards the pelvis; but not a few cases, usually those in which the patient is treated in the supine posture, may have collections of pus behind the peritoneum in the upper abdomen.

* *Guy's Hosp. Rep.*, 1874, xix.

Anatomical Considerations. — The relations of a sub-phrenic abscess to its surroundings are of the utmost importance to the surgeon. The surroundings and limitations of the abscess, possible and probable, determine the method of operation and the best seat for drainage. Unfortunately, a want of definiteness and accuracy in the post-mortem records of these cases leaves it impossible to generalise as to the probable relations of an abscess following any given cause. The surgeon has to reason backwards from the diagnosed seat of the abscess to its probable cause, and to do this with more than a moderate degree of probability is at present beyond his powers.

The *position* of a peritoneal abscess is determined firstly by the seat of its origin, secondly by gravitation, and thirdly by the guidance of the lines of least resistance. Thus, we expect an abscess originating in appendicitis to be near the cæcum; or, in the Fallopian tube, to be in the lower pelvis. But fluid from a perforated gall-bladder would gravitate behind the liver and produce its worst effects there; and fluid from a perforated duodenal ulcer has been known to produce its worst effects in the pelvis. Something will depend on the position of the patient during the progress of the disease, and this is especially true of abscesses which have got into the sub-peritoneal areolar tissue. Thus peri-appendicular cellulitis will, if the patient has been treated in dorsal decubitus, probably wander upwards and become sub-phrenic; if the patient has been walking about, it may get into the pelvis. The lowest points of the abdominal cavity are in the lumbar hollows, and if the pus gravitates anywhere it will probably be thither. It is probably the case that no patient could live till one general peritonitic abscess formed: a peritoneal collection of pus is always localised. The contents may become diffused by rupture, but this is overflow, not true formation.

One feature which is present in all varieties of sub-phrenic abscess is the tendency for limiting adhesions to form around it. There is, firstly, some amount of limitation by the natural peritoneal pouches or hollows which are so numerous in the upper abdomen. A glance at Figs. 123 and 119 will show these and

their formation. At the top of the dome the falciform ligament vertically divides the cavity into right and left halves; behind, the coronary ligament and the right and left lateral ligaments make a partial transverse division. Then from near one end of this division the gastro-phrenic ligament, the gastro-splenic omentum, and the lieno-renal ligament come down to form the left boundary of the lesser cavity. The upper layer of the transverse meso-colon comes below to form the lower limit of the upper abdomen and the lower boundary of the lesser cavity. Finally we have this lesser cavity already formed with access provided to stomach, spleen, liver, colon, first part of duodenum and pancreas. Foreign material extravasated or exuded would lie in any of these pouches if the patient remained supine and would set up inflammation in their walls. At the first point of sero-serous contact adhesions would form; and the formation of such adhesions would be predisposed to if one or both of the points of contact were at rest. Thus adhesions form most readily to the solid viscera and to the parietes, but they form at other points of contact almost anywhere.

Again, the amount of exuded material determines the points of adhesion—in other words, the size of the abscess. It may be a few ounces of fluid lying at the bottom of a pouch; or it may be measured by pints, overflowing the limits of the sac or pouch into which it was first poured and filling neighbouring pouches. Or again, from being small in amount at first, and after being limited by adhesions, it may slowly increase in size by the stretching of the abscess walls without actual encroachment on fresh peritoneal areas.

It will thus be seen that the anatomical relations are extremely complicated, and that, even if the fullest records of many cases were provided, useful generalisation therefrom would be very difficult.

An attempt has been made at p. 557 to specify the accurate anatomical relations of an abscess which may result from perforation of the gastric walls. No more need be said on the subject here. In respect of the other varieties of sub-phrenic abscess it would be easy enough to lay down seats and limits

which we might expect them to have, but as these would be mainly theoretical they are best left undescribed.

Some special points with reference to the seats of adhesions may be referred to. The foramen of Winslow is not always patent. In a fair proportion of cases—larger, my colleague, Professor Fawcett, informs me, than is generally supposed— the foramen is closed. The effects of such closure would be more often evident in cystic than in purulent collections; it would be a fortunate accident in extravasations into the lesser cavity. When adhesions form near to the surface they tend to lie between the stomach or the colon or the gastro-colic omentum and the parietes, forming a line of induration which may sometimes be palpated through the parietes. Following the falciform ligament, adhesions are often found at the hepatic notch joining liver to parietes and limiting diffusion to one or other side, and occasionally either upwards or downwards. An abscess anywhere between the liver and the stomach in front may rise up over the liver to lie in contact with the greater part of the under surface of the diaphragm; behind, in the lesser cavity, the coronary ligament of the liver prevents more than a limited contact with the diaphragm. On the left side there may be a varied involvement of cardiac end of stomach, and spleen and under surface of diaphragm.

Displacements of the organs take place according to the position of the abscess. The liver may be pushed downwards by an abscess mainly situated between it and the diaphragm; or upwards and forwards by an abscess in the lesser cavity, or between liver and stomach. The stomach may be pushed downwards by an abscess above it, or upwards by an abscess below it in the lesser cavity. But such displacements are uncertain. A chance early fixation of one of the organs, or a gradual diffusion or extension of the suppuration along the lines of least resistance, may leave the organ in its normal situation while the purulent collection surrounds it.

Retro-peritoneal suppuration may, of course, rise to any height under the diaphragm. The chief collection is usually found directly behind the lesser cavity.

All suppuration in contact with the diaphragm tends to pass through it, and pyo-thorax or pyo-pneumothorax is one of the chief dangers resulting from sub-phrenic abscess. The treatment of pleural or pulmonary complications is often one of the most serious duties of the surgeon in this disease.

The *Symptoms* of sub-phrenic abscess are, as might be expected, exceedingly varied. Some patients are seriously ill all through; others are well enough to be about. Fever is usually present, but may be quite absent. Thus a case originating in hepatic abscess may have had high temperature of a hectic type for weeks; another originating in gastric perforation may never have elevation of temperature at all. Pain is always present, worst at the seat of mischief, but diffused in various directions as well. The most characteristic symptoms relate to the implication of the diaphragm and the pleura. They are: dyspnœa, pain on deep respiration, some amount of cough, and actual symptoms of inflammation in the lower portions of the lungs and pleuræ. Expectoration of pus may be found. The upper abdomen is full and fixed, but there is not general distension such as we should expect in general peritonitis.

The diagnosis must rest mainly on the physical signs. These are sought for in the chest as well as in the abdomen. The most important sign arises from the presence of gas in the abscess, which causes some or all of the liver dulness to disappear, and may greatly modify the cardiac dulness. A localised fulness in the upper abdomen, with pain and tenderness on pressure there, and loss or great diminution of the liver dulness, suggests pyo-pneumo-peritoneum. A note of amphoric quality is sometimes elicited. But too much reliance must not be placed on this sign if there is no local pain, if there is general distension of the abdomen, and if the parietes are lax. Some coils of intestine may, in great distension of the abdomen, get between the liver and the parietes, causing resonance; and coils of bowel distended with gas underlying a thin liver may result in the production of resonance to percussion over the liver. Important signs are got from examination of the lower chest.

There we expect to find signs of pleurisy, or of pyo-thorax, or of pyo-pneumo-thorax. The collection of pus in the pleura is not usually large. These conditions are indicated by the usual signs, which need not be described.

Abscess on the right side above the liver may cause it to be depressed, but this is by no means constant. Displacement of the heart is occasionally found, but this also is not constant even in left-sided collections.

The presence of the bell-sound is of great importance in the diagnosis of the condition. Metallic tinkling and the succussion splash are sometimes heard.

In reference to the heart, there may or there may not be displacement, according to the position and the size of the abscess. If the right wing of the diaphragm is raised, the right lower end of the heart is raised and the organ is tilted. A curious fact which has been noted by several observers is, disappearance of the cardiac dulness altogether. Ewart in particular * has well illustrated and described this condition.

If there are signs of empyema in the lower chest, the exploring needle may be employed in the diagnosis. If there is elevation of the diaphragm, the needle is not unlikely to perforate it; and the pus removed, while apparently taken from the pleural cavity, may really be in the peritoneal cavity. More than one observer has called attention to this. A double abscess, both in the pleural and in the peritoneal cavities, may also be found.

Further important aids to diagnosis are got from the employment of the stomach-pump and gaseous inflation of the large bowel through the rectum.

THE OPERATION.

The line of incision for reaching the abscess is made so as to provide the best route for reaching and for evacuating it; so as to give satisfactory subsequent drainage; and—perhaps most

* *Clin. Journ.*, July 25th, 1894.

important of all—so as to avoid general contamination of the peritoneal cavity. If, through the incision, the cause of the abscess can be dealt with and removed, an important gain is made, and some additional traumatism in the operation might be justifiable to secure this end. But in every case prime attention should be given to the making of an entrance and the carrying out of the drainage without entering the general cavity.

The incision, therefore, is made at any point where the abscess lies in contact with the parietes in front or behind or at the side. If a line of induration can be palpated in the anterior abdomen the incision should be made above this line, for it indicates the presence of adhesions limiting the downward excursus of fluid. As in abscess connected with appendicitis so here, the incision should be made through a resonant patch in the centre of a circle or area of induration, because in pyo-pneumo-peritoneum this point indicates the highest point of the abscess.

The incision, therefore, may fall to be made anywhere in the epigastrium; in either hypochondrium; below the false ribs behind; and through the lower ribs laterally or behind, by traversing the pleura and the diaphragm. In this last case the line of incision will probably be guided by the exploring needle, and will have to be supplemented by resection of a portion of one or two ribs. Abbott * would always open sub-phrenic abscess through the pleura, even if there were not (as there was in his recorded case) trans-diaphragmatic connection with the pleura.

In cases where the diagnosis is uncertain, or where there are no adhesions to parietes, a median incision in the epigastrium would probably be most generally useful.

In the upper abdomen the peritoneum is usually closely adherent to the transversalis aponeurosis; and if there is peritonitis here, it will be almost incorporated with it. It may be red, and inflamed or even covered with granulations (as in a case of my own). Any gas present will at once escape. The two first fingers of the left hand are at once inserted, and, before

* *Lancet,* 1894, ii. 1034.

the fluids escape and the abscess-walls collapse, they explore the cavity and make out its exact relations and surroundings. This ought to be done quickly and deftly: the value of educated fingers will here be fully appreciated. Any opening in stomach, duodenum, or colon is felt for, and its relations with a view to operative closure are made out.

If the collection is in the lesser cavity, the omentum will have to be opened or the gastro-colic omentum divided. This may be done by teasing the omental fibres apart with finger or forceps. The under surface of the stomach is first explored; then, if no perforation is discovered, the spleen, pancreas, and duodenum.

If the abscess is found to be retro-peritoneal a careful examination should be made, to see if it is possible to make a dependent opening somewhere below the ribs behind. If the collection does not reach low enough for this, the pus should be evacuated at a suitable place through an aspirator, and drainage carried out by means of a rubber tube surrounded with gauze packing.

In the case of true sub-phrenic abscess of the first and second varieties it is doubtful whether the sac-walls should be cleansed or even whether it is wise to remove the fluid. It is certain that the abscess-walls cannot be sterilised, and any process of cleansing of the diaphragm will be attended with danger from increase of shock. If masses of solid or imperfectly-digested food are in the cavity, they should be washed out by irrigation. If only gastric mucus, pus, and gas are present, they may be left to drain. One or more large rubber tubes may be carried to the deepest parts of the abscess sac; one of these may be attached to a reservoir exhausted of air, and the sac thus emptied of fluid. This is to be done only if the patient's condition warrants a prolongation of the operation.

The method of dealing with a gastric or intestinal perforation is not yet settled. On the whole, it is probably wisest to leave it alone. If it lies deeply it is almost certainly best left alone. If it lies near to the surface and may without much increase of traumatism be closed by the insertion of a few sutures, this

should at once be done. The small experience which we have to guide us proves that the perforations will be closed by adhesions if the cavity is efficiently drained; while we know, on the other hand, that prolongation of operation is attended with increase of risk. Therefore we are fully justified in leaving to natural means the closure of any perforation of a hollow viscus producing sub-phrenic abscess.

Sub-phrenic abscess originating in disease of liver or other of the solid organs requires no special description. Any detached slough should be removed; but disturbance of the walls of an abscess-sac in the substance of the organ should, if possible, be avoided. Gauze drainage may be adopted if there is bleeding.

If drainage of the abscess has to be carried out through healthy peritoneum, gauze should be used around the tube. Sometimes after opening and emptying a retro-peritoneal collection, exploration with the finger may show that it is possible to make a dependent opening in the costo-iliac space. Such an opening is made by a stab incision from the outside down to and guided by the finger inside. The opening in the peritoneum would then be closed by suture and the parietal incision sutured without placing a drain in the cavity.

Purulent Collections in the Pelvis.

Pelvic Peritonitis.
Pelvic Cellulitis.
Suppurating Pelvic Hæmatocele.
Symptoms.
Operative Treatment.

To give an adequate account of the whole subject of pelvic inflammation would be at once to go beyond the scope of this work, and to trench on the domain of pure gynæcology. I shall therefore do little more than name the conditions found which require surgical operation; the treatment by operation, being simple and very similar in detail to operations just reviewed, will be described very briefly.

The great majority of suppurative inflammations in the pelvis may be grouped under the three heads: Pelvic Peritonitis; Pelvic Cellulitis and Abscess; and Suppurating Hæmatocele.

Pelvic Peritonitis, which ends in suppuration, depends, in the great majority of cases, on pyo-salpinx. This is a fact not sufficiently appreciated, and it is necessary to emphasise it. Bernutz, in 1857, first pointed this out, and much supporting pathological evidence has since then accumulated. Bernutz published reports of 13 post-mortem examinations of patients dying with pelvic peritonitis: in 9 one or both tubes contained pus, and in 2 tubercular products. The recent investigations of Polk, Coe, Noeggerath, Foster, Emmett, and many others, all point in the same direction. Maury* has collected much evidence in support of this fact, and considers it so important that he prints the conclusion to be drawn from his evidence in italics. He considers that it shows " that the common, every-day form of chronic pelvic inflammation which attracts the

* *Amer. Syst. of Gynæc. and Obstet.*, 1887, vol. i.

attention of the gynæcologist, as well as the simple acute pelvic inflammation which is met with unconnected with septicæmia, is pelvic peritonitis associated with diseased appendages, and is not pelvic cellulitis."

Pelvic peritonitis, not suppurative and connected with the formation of adhesions or localised collections of serum, is referred to in the section dealing with removal of the uterine appendages. Here we have to deal only with peritonitis which results in suppuration. The walls of such an abscess are partly pelvic viscera — uterus, intestines, rectum, or bladder — and partly peritoneal adhesions. Somewhere in the abscess-cavity, being similarly disposed, both as to locality and as to cause, with a perforated vermiform appendix, lies the diseased ovary or tube which is the cause of the mischief. The intestines are matted together around the suppurating focus, and their function may be so interfered with as to produce symptoms of intestinal obstruction.

Pelvic Cellulitis is retro-peritoneal, and involves the whole of the para-metric cellular tissue and its extensions; that is to say, it may involve the connective tissue which surrounds the cervix and upper vagina, passes up the sides of the uterus between the layers of the broad ligaments, and outwards between these structures as far as the sides of the pelvis, and even beyond this in the cellular tissue which rises over the peritoneum under the abdominal parietes. In any part of this large area an abscess may form either as a direct result of traumatism or as a septic invasion through the abundant lymphatics. In this category must be included suppurating pelvic lymphatic glands.

The most important variety of pelvic cellulitis is that following delivery; it is often one of the lesions found associated with puerperal fever. In these cases there is a possibility of finding a multitude of small abscesses in the broad ligaments and the areolar tissue surrounding the uterus. Amongst a few operations which I have performed for this condition, one case under the care of Mr. Pagan Lowe of Bath, and another under the care of Dr. Awdry of Berkeley, were remarkable for the

multiplicity of the abscesses found. Both patients recovered. Usually at operation one or two collections of pus at most are found ; it is fortunately not often that the peri-uterine tissue is everywhere riddled with abscesses.

The abscess may burrow in almost any direction in the pelvic cellular tissue, and may point in an endless variety of situations in vagina, rectum, or bladder, and through the parietes almost anywhere below the umbilicus. The purulent collection is always sub-peritoneal, and rarely bursts into the abdominal cavity, being usually fatal through high temperature and septic absorption.

Suppurating Pelvic Hæmatocele is usually extra-peritoneal, and situated between the layers of the broad ligament. Intra-peritoneal hæmatocele is most frequently fatal before suppuration can take place ; but examples of degenerations of sanguineous fluids, apparently exuded *guttatim* from an unhealthy tube during menstruation, have been recorded. A suppurating pelvic hæmatocele is, when fully developed, clinically and anatomically very similar to pelvic abscess originating in cellulitis.

The *symptoms* of a collection of pus in the pelvis are sufficiently definite, and do not require detailed description. The constitutional signs of suppuration are usually well marked ; the temperature is usually high, sometimes very high. The diagnosis can be made only after a careful digital and, if necessary, bi-manual examination by the vagina and rectum. It is impossible to insist too strongly on the importance of digital examination. Percussion through the parietes may be misleading on account of distension of the intestines, and palpation from the front may reveal nothing. A pelvic abscess may, and frequently does, kill a patient without producing a single external sign to the examining hand or eye beyond abdominal distension and fixation of the parietes. In every individual with symptoms of suppuration inside the abdominal cavity, whatever be the history of the case or the age of the patient, a careful and exhaustive vaginal or rectal examination should be made.

Such an examination will reveal either induration, with a localised enlargement somewhere in the pelvis, or a positive collection of fluid. This collection may occupy Douglas's pouch, and bulge into the vagina behind, displacing the uterus forwards; or it may lie on one side of the uterus, pushing this organ to the opposite side, and forcing downwards the vagina laterally; or it may seem to occupy the whole pelvic cup, pushing down its floors and surrounding the true pelvic organs. In other cases there is only induration along the cellular planes in the pelvis, while the purulent collection lies near to the abdominal surface, or actually in the abdominal wall.

The diagnostic examination usually causes great pain, and may have to be conducted under an anæsthetic ; in every case the surgeon should be prepared to operate at once on the diagnosis being made, and while the patient is still anæsthetised.

Operative Treatment.—The indication to operate in suppurating pelvic inflammations is as clear and definite as the indication for any other abscess, and should be acted upon without delay.

As to the mode of operation, two conditions of prime importance must be taken into account : one is the condition of the patient ; the other, the point at which the abscess may most easily be reached and drained. My experience is, that these patients, when the surgeon is called in, are very ill, with exceedingly high temperature (104°—106°) and profound constitutional disturbance. In some of them there will be symptoms of intestinal obstruction. I have had several such cases in my own practice, where the condition I was called in to treat was described as intestinal obstruction. All these influences combine to add to the risk of any difficult or prolonged operation. Again, the position of the abscess must be taken into account. An abscess lying low down in the pelvis cannot be drained through the anterior parietes without carrying the pus through a healthy district of peritoneum, and thereby inducing risk of general peritonitis. Such an abscess may positively invite opening through the vagina. And this invitation, if the patient were at all ill, I should unhesitatingly

accept, even though I did not at that operation discover and remove the cause of the mischief. Another advantage of the vaginal opening is, that it can be made without the use of an anæsthetic, and very slightly upsets the patient.

I am aware that, in urging these views, I am at variance with very high authority, which enjoins a uniform opening of pelvic abscess by abdominal incision. I would urge that many of these cases are so ill that the administration of an anæsthetic and abdominal incision are proceedings infinitely more grave than a simple puncture through a mucous membrane; that drainage by vagina can efficiently and safely be carried out so as to cause immediate collapse of the abscess sac; and that if the issue of the case proves that the origin of the disease—a suppurating ovary or tube—remains and requires removal, this may be done later on, when the patient has escaped the immediate risk to life and has gained strength.

In one such case I found, after abdominal incision, that the abscess-sac lay so deeply in the pelvis that its walls could not have been brought to the surface; I therefore opened it into the vagina, and closed the parietal wound. In another case—an enormous pelvic abscess, the horribly fœtid contents of which spouted over our heads through the long exploring needle—I was unable to bring the walls of the sac to the abdominal opening, and the drainage tube had to be carried through healthy peritoneum. In a case exactly similar to these, about five pints of horribly offensive pus were evacuated by vaginal incision; and the patient, although in the last stage of exhaustion, made an excellent recovery. Two Infirmary patients treated in the same way did equally well, and one of these would almost certainly not have borne abdominal operation.

While I advocate, for these conditions, the application of the maxim " Ubi pus, ibi evacua," I would not seek to contest the theoretical advantage of operating by a method which will enable us to satisfactorily deal with and remove the cause of the disease. Many cases, chiefly those in which the abscess is small, can be dealt with only by coeliotomy; and others

are met with in which coeliotomy is quite permissible, from the fair condition of the patient. In all of these, the direct incision through the parietes should be selected.

A detailed account of the operation would be a mere repetition of previous descriptions. The wall of the abscess is usually more or less completely covered by adherent intestine: a part on the surface is looked for to which intestine is not attached, and here the aspirator needle, guarded with one or more sponges, is inserted. As the sac collapses it is drawn towards the surface by means of catch-forceps, and if possible attached to the parietal wound by a continuous suture. In those cases where the sac is an adventitious one composed of the walls of adherent viscera, this is impossible, and the cavity must be drained by a tube or strips of gauze carried to its bottom. Here the cavity should be thoroughly cleansed by irrigation and mopping with sponges charged with antiseptic material. Diseased appendages, if discovered, are of course removed. Adhesions between intestines need not be broken down unless it is necessary to do so on account of secondary collections of pus. The breaking down of adhesions seems to add greatly to the condition of shock, and it is doubtful whether such separation of adherent surfaces is more than temporary. It is possible to do too much in these cases; a complete and perfect surgical technique may be carried out at the expense of the patient's life. The first essential is evacuation of pus and provision for drainage; then we may seek to isolate the cavity of the abscess by suturing its walls to the parietal opening; irrigation and cleansing, with separation of adhesions and removal of cause, is the final proceeding, to be carried out only if the condition of the patient will warrant it.

Tubercular Peritonitis.

Mortality and Appreciation.
Pathological Anatomy.
Operation.

The operative treatment of tubercular peritonitis has been stumbled on by accident, rather than carried out by design. A good many cases of operation for encysted cases of this disease have been performed by mistake for ovarian dropsy or other allied condition. Many of these were found to recover, and hence coeliotomy for tubercular peritonitis of a certain class has come to be carried out with deliberate purpose as a mode of treatment promising success. Possibly four hundred such operations have been performed in the last twenty years.

Mortality and Appreciation. — Dr. Kuemmell of Hamburg* collected 30 cases of this kind, beginning with one of Spencer Wells, in 1862. Of these cases, only 2 died directly from the operation; 3 died from tuberculosis in periods varying from 5 to 12 months. Altogether there were 25 cures, of from 9 months to 25 years' duration. König later collected 131 cases of operation, of whom 75 per cent. were much benefited and 25 per cent. cured. Hawkins † collected 112 cases of operation, of whom 28 died at once or soon after operation; 26 were not traced, and 57 more or less completely recovered. He calls in question the generally accepted belief as to the success of operation, and quotes the results of 100 cases of tubercular peritonitis treated medically in St. Thomas's Hospital. Of these 100 cases 59 recovered and 40 died; and he infers that operation slightly or scarcely at all improves the mortality. Additional force is given to his reasoning if we remember that of the medical cases those that

* *Centralbl. f. Chir.*, 1887, xxv. † *St. Thos. Hosp. Rep.*, xx., 1892.

die are least likely to escape being reported, while of the operations the failures are the ones that escape being reported. The largest collection of cases yet made is by Aldibert,* and his conclusions are more favourable than Hawkins' as regards the utility of operation. Thus, in 308 cases of operation there were 74 deaths, of which only 2.5 per cent. were directly due to operation, and 215 cures ; a per-centage of 69.8 per cent. of cures, of which about half were claimed as complete and permanent. Thus all statistics give a proportion of from 25 to 33 per cent. of complete cures. Certainly this is less favourable than probably most surgeons would have expected, and hardly more favourable than the result of simple medical treatment as recorded by Hawkins. Personal experience is perhaps more valuable than statistics. I have operated on about twelve cases, but I can point to no certain cure. None died of the operation ; all of the patients were improved, and six are apparently cured, one remaining well after ten years and the others from two to eight years. The most promising case is that of a child in whom an accidental inroad of putrefactive bacteria was followed by free suppuration and discharge of caseated products, with apparently complete cure. My impression is certainly in favour of operation. Quiescence of disease follows most operations, and this quiescence may last over years. I should hesitate to affirm cure of any case till after a longer period than is put to most of the recorded cases of cure. The best that can be said of operation for tubercular peritonitis is that a considerable number of patients have had their lives prolonged thereby, and that about one-fourth of the cases are cured. This is sufficient to justify an operation which is attended with a very slight immediate risk.

Pathological Anatomy.—Aldibert divides tubercular peritonitis into three varieties: the ascitic, the fibrous, and the ulcerative or caseating. This division is in harmony with the clinical features as the surgeon meets them. Peritoneal tubercle as part of general miliary tuberculosis does not concern the

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* *De la Laparotomie dans la péritonite Tuberculeuse.* Thèse de Paris, 1892.

surgeon. Tubercular peritonitis in so far as the surgeon has to deal with it, is essentially a local disease.

The ascitic variety of tubercular peritonitis may have the fluid either diffused through the cavity or encysted in some part of the abdomen. Grey granulations are found studded irregularly all over the serous membrane concerned in the disease. The ascitic fluid, whether localised or diffused, is usually clear, pale yellow in colour, and rarely blood-stained or semi-purulent. It may be abundant in amount. When the fluid is encysted the condition is often mistaken for ovarian tumour.

The fibrous variety is marked by an abundant development of fibrous tissue replacing the serous membrane and often binding the organs together. In the fibrous material are found large tubercular nodules either rising to the surface when adhesions may not be present, or lying deeply in its meshes if there are adhesions. There is little or no ascitic fluid, or if there has been it has disappeared. This variety is said to represent a stage in the progress towards spontaneous cure.

In the ulcerous or caseating variety, the tubercles have become confluent and degenerate in the way peculiar to themselves. Sometimes there is a large mass of cheesy material lying amongst the intestinal coils loosely bound together by adhesions and partly encysted in one or many loculi. Here and there foci of suppuration may appear, and these joining may form a large confluent abscess with walls partly formed by adhesions and partly by the entangled bowels or omentum. In the abscess besides pus are found masses of caseated material, either loosely attached to the abscess-wall or floating free in the abscess sac.

Operation.—How operation cures tubercular peritonitis we do not know; if we knew, we might vary the method in the direction of the curative process, and so get better permanent results. Morris * is inclined to believe that it is through the admission of putrefactive bacteria, which produce a toxalbumin which is fatal to tubercular bacilli. Certainly the most perfect

* *Phila. Med. News*, Oct. 13, 1894, Abstr. in *Brit. Med. Journ.*

result which I have got was after accidental invasion of the peritoneum by putrefactive bacteria in the case of the girl quoted above, and hers was the worst case I have operated upon. Deliberate inoculation with putrefactive bacteria is, however, a proceeding which few surgeons would dare to carry out as a therapeutic measure. The admission of light and of atmospheric air, which are undoubtedly deleterious to the life of tubercle bacilli, is believed by some surgeons to be the beneficent agent. If this is so, the surgeon could easily work towards this end. Other surgeons ascribe the result to the beneficent effects of operation *per se*, which must simply mean traumatism or the addition of a new and more acute inflammatory agent to the old and chronic influences at work. Possibly all these influences may contribute to the cure. But until we are certain as to the method of cure we cannot dogmatise as to the actual surgical measures to be adopted. The number of cases is too small, and the variety of them too great, to draw any useful conclusions from. If it has happened (as it has) that a 72.5 per-centage of cures has followed incision with irrigation, and a 74.3 per-centage of cures has followed incision without irrigation, we are not to infer that it is better not to irrigate. And so as regards drainage : it may be that the simplest cases are not drained and that the most severe ones are drained ; but we are not therefore to conclude that, because the results in the undrained cases are better than in the drained, drainage is unnecessary. And so of the employment of antiseptic fluids or emulsions, we can draw no con- clusion beyond this, that they are not essential to recovery and may do harm. We have, therefore, no other than somewhat vague empiric guidance as to what we shall do in any given case of tubercular peritonitis. Personally, I should place most reliance on drainage. But I should, where possible, make a free exposure of the area of disease to the atmospheric air and apply some harmless antiseptic material, such as boric emulsion, to the diseased surfaces. This causes some amount of traumatism, which is almost certainly beneficial ; and to make the application the incision must be large, so giving the possible advantages

which may follow the admission of air and light. Also, I should always remove caseated products. Some of my best results have followed this proceeding. In one case (a patient of Dr. Maclean, of Swindon) of a phthisical young lady I dug out with a teaspoon several ounces of caseated material from between bowels and omentum, and got primary healing of the parts. This lady is now strong and well, and has since married and borne one child. In another case (a patient of Dr. Clarke, of Marshfield) I removed with scoops at least a pint of curdy tubercular material from several centres in the pelvis, originating apparently in the Fallopian tube. She made a slow but steady recovery. A year after operation I had to re-open the abdomen for a cystic collection containing several pints of clear fluid which had originated in another focus. She is now rapidly putting on flesh and is in excellent general health, without a trace of pelvic induration or matting to be felt through parietes or vagina. I cannot believe that it is other than good surgery to remove these caseating masses. It is true that their removal may be difficult and that the disturbance of adhesions may be dangerous; but if the result can be secured without serious injury to the parts, it should always be aimed at. In any case provision for the future exit of tubercular *débris* should be made by the judicious placing of drainage tubes.

For drainage, Treves prefers the gauze drain to the rubber tube. One objection to the gauze drain is that it soon gets infiltrated with lymph, when it ceases to act; and another when it is pulled out, is that it may cause bleeding with the formation of an intra-abdominal clot. It certainly has the advantage of setting up traumatic irritation in the wall of a tuberculous sac, and as this is probably a praiseworthy effect, I think the employment of the gauze drain for 24 hours or so is to be advised. But thereafter I should employ a rubber tube of generous dimensions; or several small tubes, each placed in a recess. It is true that sinuses are apt to follow the prolonged employment of a drainage tube. But there is no harm in this, but rather good, for the continuance of the sinus means the persistence of disease; when the morbid process ceases, the

sinus will close spontaneously. My experience of a sinus in abdominal surgery is simply that of general surgery, that a sinus persists only so long as there is a necessity for it to carry off secreted or excreted fluids or foreign matter.

More specifically, in operating on the individual varieties of tubercular peritonitis the following directions may be given :

In the ascitic form of tubercular peritonitis, simple evacuation of the fluid by parietal section has been followed by cure. But, if the fluid is encysted, free exposure of the inside of the sac, with mopping of its walls, should be adopted. If the ascites is diffused all over the cavity such a proceeding is scarcely possible, and to attempt it would be greatly to add to the severity of the operation. So also irrigation is not called for. It certainly cannot locally affect the tuberculous process to run hot fluid over the tuberculous surface, and it may add to the operation shock to do so. If the fluid is encysted it need scarcely be said that an attempt should be made to evacuate it without passing through the general cavity, and certainly without letting the fluid into it.

In the fibrous variety operation has been both urged and condemned. These fibrous cases may have several processes going on : there is fibrillation ; there may also be small patches of caseation ; there may be minute or medium-sized abscesses forming ; and finally there may be young tubercles forming. If there are found only fibroid changes, and the adhesions are strong and firm, they are best left alone. But the surgeon cannot tell what is the state of affairs till he has opened the abdomen : the exploratory proceeding can have done no harm, though it may do no good. If small caseating or suppurating collections are found, these are removed by scoops with as little separation of adhesions and disturbance of parts as is possible, and drained by several small rubber tubes. Occasionally a small cavity may be cleansed by a piece of sponge held in a forceps. But such cases should be dealt with circumspectly and with as little disturbance of parts as may be.

In the ulcerous or suppurating variety an attempt should always be made to evacuate and drain. If the abscesses are

numerous and diffused generally through the abdomen, complete evacuation should not be attempted ; but the emptying of one or two collections nearest to the incision and drainage of their sacs may help towards cure. In these cases the patient is always seriously ill and will not bear prolonged operation ; this is one reason against attempts being made at complete evacuation. Another is, that these abscesses often communicate; and if one is emptied, another finds an exit through this one, and so on. The process of cure may and must be tedious; but the patient is put in the way of recovery, and may slowly get well. If there is only one encysted caseated or semi-purulent collection, this should be thoroughly evacuated and its walls cleansed by sponging. We may even, if satisfied that the walls are thoroughly cleansed, dispense with drainage and hope for primary healing. But drainage for a few days at least will usually be advisable. These tuberculous cases have an unhappy habit of eventuating in the formation of intestinal fistula, and the presence of a drainage tube or of the lymph-track which it leaves may prevent disaster.

In these cases it is advisable to get the patient out of bed and out of doors as soon as possible. Fresh air and sunlight are as important as drugs, or drainage, or antiseptics. Above all is it essential that the patient should not be habituated to hospital existence. The local management of the case surgically is on the ordinary lines, and requires no description.

Peritoneal Adhesions.

Occasionally it is necessary, on account of various troubles produced by peritonitic adhesions, to operate for their relief. Several surgeons have recorded isolated cases. Mayo Robson, in particular, was amongst the first to advocate operation for the condition and to record successful cases.

The origin of these adhesions is very varied: there is no kind of peritoneal inflammation which may not result in the formation of fibrous tissue uniting the organs involved. Thus, it is the rule to find abundant adhesions around the gall-bladder in long-standing cases of cholelithiasis. Repeated slight attacks of salpingitis, or one acute attack, will almost certainly be followed by the formation of adhesions, which are sometimes so extensive and so strong as to become matting. The plastic lymph thrown out over a gastric or an intestinal ulcer may become drawn out into a long band, or may closely bind bowel to bowel or other organ.

Adhesions so formed may give rise to no symptoms; but occasionally they do beget trouble. This may occur in various ways; but we may expect them to be at their worst when an organ naturally mobile is bound down and fixed; or where two organs naturally mobile become attached and the adhesion becomes stretched, forming a peritoneal false ligament in which the bowels become entangled.

I have operated on several such cases, and as they would probably be considered fairly representative of the conditions met with, a description of them may be made to suffice instead of a generalised description.

One case was that of a married woman in hospital who suffered from acute attacks of agonising pain in the lower abdomen. These attacks occurred at irregular intervals: sometimes only a few hours intervening, sometimes weeks. They had lasted over a year. She had some abdominal distension during and after the continuance of the pain. At

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operation a thread of tissue eight inches long, as thick as No. 4 Chinese silk twist and almost as strong, was found intertwined amongst several coils of the small intestine in the pelvis. One extremity of the thread was attached to the left Fallopian tube, the other end was fixed to some part of the sigmoid flexure. The tensile strength of this thread was quite extraordinary; it cut into the skin of the finger when attempts were made to break it after removal. Recovery was immediate and complete.

A second case was that of a young lady under the care of Dr. Dunbar, of this city. She had become greatly emaciated from constant vomiting, and had some pain in the epigastrium —not severe and not constant. There was moderate but not excessive gastric dilatation. The vomiting occurred at all times, and had no special connection with food. At operation the pylorus was found adherent to the anterior parietes along with the gastro-colic omentum and the colon. The adhesions were not strong and were detached with the greatest ease, very little bleeding resulting. Nothing abnormal was found in the gastric walls or the pylorus; not the slightest thickening to suggest old ulcer was detected. The adhesions were separated and nothing more was done. The result was immediate cessation of all gastric troubles and rapid improvement of the general health.

A third case occurred in hospital, and was in a married woman who had borne numerous children. She was never free from pain in the lower abdomen, and had suffered for several years in spite of varied and intelligent treatment. The pelvic organs were absolutely normal to examination and no diagnosis could be made, although adhesions were suspected. The tip of the vermiform appendix was found to be attached by a long and thick adhesion to the *left* ovary; and there was some general matting between bowels, omentum and ovary, the exact nature of which was not ascertained as separation was made by the fingers out of sight. When these adhesions were separated the band was made out, one end was separated from the ovary, and the other was found, on its being delivered, to be the vermiform

appendix, healthy enough but elongated. It was not easy to say where the appendix ceased and the band began. The appendix was not removed (the operation was done twelve years ago) nor any other organ, and recovery was complete, and, so far as I know, permanent.

A fourth case was that of a married lady who had a clear history of pelvic-peritonitis following a chill received during a menstrual period. There certainly had been no gonorrhœa. She had been acutely and seriously ill for a fortnight with vomiting and abdominal distension. She had got fairly well at the end of two months, but gradually she had begun to suffer from pain in the lower abdomen, and especially over the bladder. Micturition always aggravated the pain; as the bladder refilled, the pain was usually relieved. One Fallopian tube could be felt fixed, but it was not enlarged and not tender. The pain at the end of two years became so severe that she gladly submitted to operation. An extraordinary number of fine thread-like adhesions were found binding several coils of small bowel down in Douglas's pouch to the back of the uterus and to the fundus and peritoneal surface of the bladder. They were as numerous and as fine as a spider's web; but considering their size, they were of remarkable strength. A bundle of them rolled together was cut off, and when floated out in water they were seen to be quite separated in their whole length and of uniform thickness throughout. The Fallopian tube was raised out of Douglas's pouch and the meso-salpinx shortened by a single puckering stitch. The patient soon recovered and is now practically well.

Such cases, and similar ones which have been reported, undoubtedly prove that the mere presence of peritoneal adhesions may be a cause of pain and illness, the only cure of which is operation. Diagnosis can be completed only by operation; in one sense, therefore, operation is exploratory. But a presumptive diagnosis is nearly always possible, often rather by exclusion of other conditions than by positive inference of adhesions. On this presumptive diagnosis operation may be performed with propriety and with a high probability of cure.

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